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PHYSICAL MEDICINE
and **REHABILITATION**

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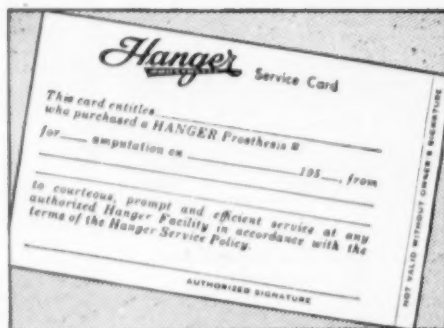
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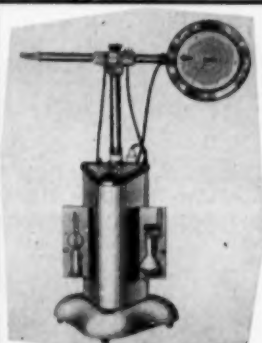
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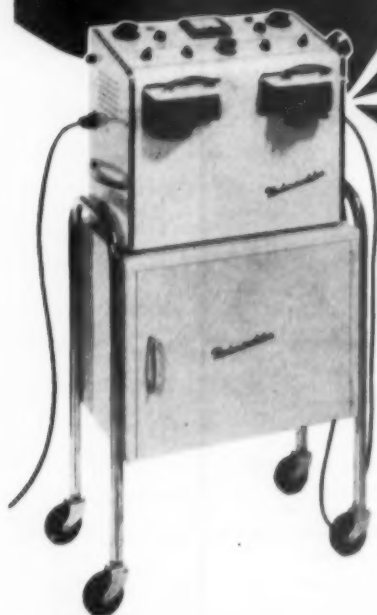
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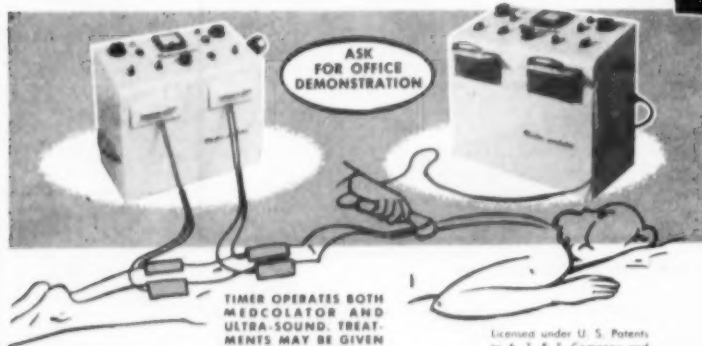


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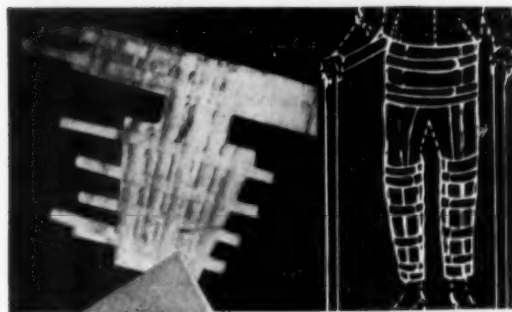
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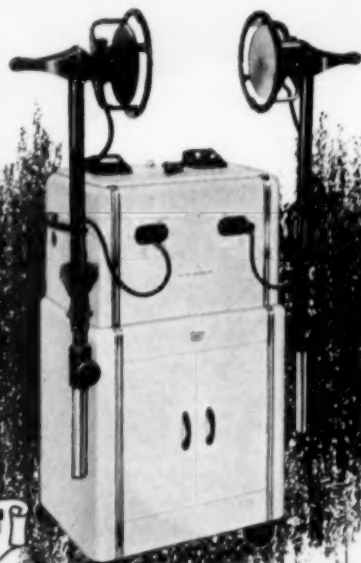
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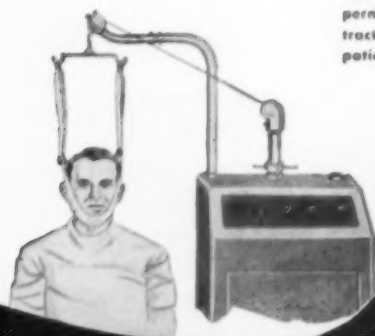
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The Sixth John Stanley Coulter Memorial Lecture: Some Problems of Communication in Medicine as Illustrated by the Coulter Bibliography

Frederic T. Jung, M.D., Ph.D.
Chicago

Dr. John Stanley Coulter died in 1949, only 7 years ago. A eulogy giving the facts of his birth, education, and medical career was delivered in 1951, as the first of this series of lectures by Dr. Kristian G. Hansson.¹

Since that time, the American Congress of Physical Medicine, of which he was a member, has added the words "and Rehabilitation" to its name, and the Council on Physical Medicine of the American Medical Association, of which he was chairman for many years, has been succeeded by the Council on Medical Physics. Death has taken some of those who worked closely with him; I am thinking especially of Dr. Stafford L. Osborne, who was so closely associated with him at Northwestern University, and of Miss Marion Smith, who was so effective in her work as Executive Secretary of the American Congress of Physical Medicine and Rehabilitation and as Registrar of the American Registry of Physical Therapists. Since other close associates of his survive, however, it would be desirable to secure more of their impressions of him while the opportunity to do so exists.

One reason why Dr. Coulter's attitudes on various subjects are of interest to us today is the admitted clash of ideas recently manifested between physiatrists and orthopedists. His gift for tactful, constructive action would probably have enabled him to find a solution for this problem, but I think he would have been surprised that such a problem should have arisen at all. As will be seen presently, his interest in physical therapy and rehabilitation grew quite naturally out of his interest in orthopedics, especially dislocations and fractures. He not only gained inspiration from his friends in orthopedics, but he depended on them professionally. He never pictured either the physiatrist or the orthopedist as any-

thing less than a completely qualified Doctor of Medicine. One can picture him raising his eyebrows at the thought of orthopedists quarreling with physiatrists over the right to sign an order for an artificial leg.

The list of Dr. Coulter's publications contains 171 papers, one book of which Dr. Coulter was sole author, two books of which he was a co-author, and three books to which he contributed substantial sections. Some of his articles were reprinted in the successive editions of the "Handbook of Physical Therapy," the "Handbook of Physical Medicine," and (1950) the "Handbook of Physical Medicine and Rehabilitation" published by the American Medical Association. The last edition contained some new articles not printed previously, by authors whom he recommended to the A.M.A. Council on Physical Medicine and Rehabilitation. He was much interested in the last edition although he was already handicapped by symptoms of cerebral vascular disease.

If the subjects of Dr. Coulter's papers are studied chronologically, some interesting facts emerge. His first publication was a study of the pathology of the gall-bladder and biliary passages in cholera; it appeared in the *Philippine Journal of Science* in 1915. It remained his only contribution on tropical disease, and the only other papers showing any interest in the gastrointestinal tract came many years later. Three of these, between 1939 and 1943, were concerned with gastrointestinal tuberculosis and espe-

Read at the Thirty-fourth Annual Session of the American Congress of Physical Medicine and Rehabilitation, Atlantic City, N. J., September 12, 1956.

Assistant Editor, *Journal of the American Medical Association*; Lecturer in Physical Medicine, Northwestern University Medical School.

Acknowledgment: Valuable information for this lecture has been supplied by Ben L. Boynton, M.D.; Mr. Howard A. Carter; Miss Gertrude Beard; Mrs. Emma Spinka, and Mr. Anthony J. McKay.

cially with the possible use of ultraviolet radiation in that condition.

During World War I, Dr. Coulter was in the Regular Army, and part of that time he was in the Surgeon General's Office, associated with Dr. Paul B. Magnuson. When Dr. Magnuson left the service and went to Chicago to practice industrial surgery, he persuaded Dr. Coulter to resign from the Army and to become associated with him in Chicago.

This association resulted in a magnificent series of short articles published jointly by Coulter and Magnuson, their names alternating as senior and junior authors, in the *International Clinics* of 1920 and 1921. These are case reports of industrial injuries, especially fractures and dislocations. They make interesting reading because they are so objective and concrete. They are usually chosen to show how much of a difference proper treatment can make. In one, entitled "Fracture Dislocation of Scaphoid and First Cuneiform," they say:

This patient was injured on September 6, 1919; he was examined on April 12, 1920. During this time it had not been recognized that he had a dislocation of the semilunar bone. The patient had been given massage and forcible flexion until the capsular ligament of the wrist joint was so traumatized that the patient not only had extreme pain on pressure on the anterior capsule, but no doubt many torn fibers in the posterior capsule, from an attempt to force flexion in a joint where a bone was actually blocking the movement in that joint. Flexion of the wrist in this condition is just as impossible to obtain as the shutting of a door if a crowbar were forced between the surfaces of the hinge.

There have been seven months' disability in this case, about two hundred dollars spent for massage which had done the patient great harm instead of decreasing the disability, and the patient now has 75% loss of use of the arm because of the pain produced upon any motion of the wrist.

Another of these reports is entitled "Overzealous Splinting":

A carpenter, age 34, while riding in

an automobile, was involved in a collision and his left ulna was fractured about three inches above the wrist. . . . The arm was set on the same day and put up in board splints, anterior and posterior, down to the base of the fingers. The boards were bandaged on snugly and were not removed for two weeks, in spite of the fact that the patient complained of pain and numbness and finally of a bad odor from the arm. When the splints were finally removed, it was found that there was an ulcer about four inches long over the back of the hand and wrist and another over the anterior surface of the wrist. . . . He says that his fingers were numb continually and that he had very slight motion in them. The doctor told him to leave the splints on as it was necessary to have them tight. This patient exhibited a striking case of Volkmann's ischemic contracture, which resulted in the permanent total loss of use of a hand.

While most of the papers of this early series deal with fractures and dislocations, some deal with nerve injuries and the use of electro-therapy. One paper mentions especially the Bristow coil and tells the medical reader how to make one. Four deal with arthritis; three with malingering and hysteria; seven with pain and other problems involving the back (also mentioned in five other papers); one with radiography. Especially significant is one entitled "Physiotherapy in Industrial Surgery."

In the introduction to this series, Dr. Coulter remarked that he had recently resigned from the Regular Army Medical Corps after 9 years of service to engage in general industrial surgery in Chicago. It was through the impression made upon him by examinations at the Industrial Commission that he urged the publication of at least part of the material he saw there so that attention might be called to the divergence in many cases "between the things that we had all been taught and which were in the textbooks, and how these things work out in actual practice."

He presently decided that he was not to be an industrial surgeon; instead, he

set up an office in Chicago where he employed a physical therapist. Dr. Magnuson referred a great amount of his industrial work to him for physical therapy. In the opinion of some, the establishment of this office was the beginning of Physical Medicine as a specialty. There were other physicians at that time devoting much or most of their time to it, but he was one of the first, if not the first, to take patients on a referral basis only and so to avoid the suspicion or criticism of retaining patients sent to him by other physicians.

Another turning point was the construction of the Ward Memorial Building of Northwestern University Medical School. Dean Irving S. Cutter, who was much interested in physical therapy, and Dr. Coulter worked harmoniously in planning the floor space and equipment of the new department of physical therapy there. Dr. Coulter became its head.

In 1925 he published the first article in which he pleads for the use of physical therapy in general practice or in various specialties. The promotion of physical therapy became his major concern. He wrote 18 papers of this kind between 1925 and 1946. His first papers on massage appeared in 1938; the first of a number on occupational therapy (especially on the need for medical supervision) appeared in 1939. In 1932 he became interested in diathermy, and the last of 16 papers on this subject is dated 1940; these papers cover the period of conventional long-wave diathermy with fenestrated electrodes and other crudities as well as the later short-wave diathermy.

There is a considerable list of papers dealing with the problems of organizing a physical therapy department, the education of personnel, the work of the Council on Physical Therapy, and especially the significance of the American Registry of Physical Therapy Technicians.

In his new department at Northwestern University, he instituted an excellent course for the training of physical therapy technicians. With the help of many loyal associates he built up a department that not only trained students

but also produced critical research. In getting articles ready for publication it was his custom to pass them about to the medical and technical staff and invite comment before putting them into final form. This improved the articles and gave everyone a feeling of having contributed.

He communicated his ideas not only in writing, but also in innumerable speeches. He gave, of course, the lectures to the medical students. But in addition, in the words of one of his associates:

He never refused an opportunity to appear on a program of state or county medical societies and he travelled all over the country presenting the simple, practical part of physical therapy, heat massage, and exercise, which could be used to advantage by everyone in the medical profession. He would start out with his "bag of samples" as he called them — his reprints and those sheets of specifications for "homemade" equipment supplied by the Council on Physical Therapy of the American Medical Association.

Dr. Coulter's writings and speeches exemplify solutions of several problems of communication in medicine. The doctor must communicate with the patient, the patient's relatives and friends, and the public generally; with his assistants and students; with manufacturers, and with other physicians.

In communicating with the patient, with his relatives and friends, and with the general public, a prime requirement is that the doctor should make himself perfectly clear. This is more of a problem than many suppose. Speakers' bureaus operated by medical societies commonly receive the complaint that medical speakers before lay audiences either do not make themselves heard or do not express themselves well. A recent study of the meaning of medical words to average people gave disconcerting results. Such words as "anemia," "enriched," "hemoglobin," "rickets," and "protein" were understood by less than 20 per cent of the patients questioned.

Dr. Coulter got along well with non-professional audiences. He knew how to

choose concrete subjects and how to discuss them in operational terms. He had a quizzical air of alertness and was always in touch with the audience. He demonstrated physical facts. He said that if he could understand them, other people could.

He did not write much for popular magazines. It is possible that the presentation of physical therapy to the public needs more thought at the present time. The public has a short memory. There should be more good articles on physical medicine and rehabilitation at frequent intervals in *TODAY'S HEALTH*.

In communicating with students and associates, Dr. Coulter had the same direct, unaffected approach. His lectures to the medical students at Northwestern University were typical, as can be brought out best, perhaps, by contrast. Another lecturer in physical medicine set up an elaborate demonstration for the administration of histamine to an arthritic patient by electrophoresis. An uncomfortable class sat through the complicated preparations, but no convincing results were obtained since nothing visible transpired. Whatever the value of the demonstration, it had little significance to most students. When Dr. Coulter lectured, on the other hand, he would come into the room with, for instance, a set of mimeographed directions for a particular therapeutic exercise. Any student whose attention wandered from what was being said could at least rivet his attention on what had been written. The instructions contained valuable technical hints, the *modus operandi* was easily understood, and curiously, the directions are as good today, 25 years later, as they were then.

Communication between the physician and the manufacturer of diagnostic or therapeutic apparatus has at times been very poor indeed. Among the bitterest complaints, and the best founded, are those coming from manufacturers who have been misled as to the possibilities of a new kind of treatment and have invested heavily in developing new apparatus. Sometimes they have been guided by off-hand opinions of doctors, but sometimes they have been convinced by

a generous number of published clinical reports. The manufacturer may not realize that a persevering exegesis of medical literature can prove almost anything. He may not know that medical research is beset with pitfalls that trap even experienced investigators. He is puzzled when he finds contradictions in what should be reliable publications, and he is embittered when, in a disputed case, some scientific council takes a dim view of the favorable reports and prefers to believe the unfavorable ones.

It is useless to tell most people that experiments must be "controlled." They think they know what that word means, but they do not, and neither do some scientists. In science, the word "control" has a tricky, arbitrary meaning, and it is not defined in every textbook. For a manufacturer to finance what he supposes to be "controlled" research, only to find out later that his evidence is still unsatisfactory, must sometimes be the last straw that overstrains his patience.

The Council on Physical Therapy was one medium of communication between physicians and manufacturers. Under its aegis, conferences were occasionally held with manufacturers of certain classes of apparatus, such as diathermy generators, audiometers, hearing aids, infant incubators, and apparatus for artificial respiration. At such meetings, Dr. Coulter frequently served in the role of "deflector of controversy." His intuition told him where trouble threatened, and his ability to see the humor in a situation prevented many an argument from becoming an altercation.

Technical exhibits at conventions continue to furnish conditions favorable for communication between physicians and manufacturers. There seems to be no limit to what manufacturers can make—devices enormously large or microscopically small, permanent or disposable, flexible, transparent, sterilizable, and so on. But manufacturers still complain that it is difficult to know what physicians would really like to have. This need has been recognized by the Rockefeller Institute for Medical Research in arranging a series of conferences between manufacturers and physicians.

Lastly there is the problem of communication among physicians themselves. A recent number of the *American Journal of Psychotherapy* (July, 1956) contains an illustration of this in the form of an article entitled "Communication Difficulties among Psychiatrists." Dr. Coulter's bibliography shows that he published in 38 different periodicals, including two printed in Spanish. How much farther he reached out beyond the geographic and linguistic barriers about him would make an interesting study. This brings us to one of the important points of this paper.

It is a pity that so much excellent foreign literature is a closed book to so many Americans and that our own language, which is admittedly hard for our own children to learn, should be so difficult for foreigners. Publications in French and German fail often to receive the attention they deserve; the less widely spoken languages like Danish, Portuguese, and Dutch suffer even more, and the languages of large nations like Russia, China, and India, because of the remoteness of their relation to the Teutonic and Romance languages, are considered out of the question. It is getting harder and harder to persuade American students to study even Latin or Spanish, easy and important though they are, and to the American medical student the reading of a scientific contribution in any language but his own is a most laborious undertaking.

Elaborate machinery exists for the purpose of making medical discoveries accessible to people in other countries. The American Medical Association, for instance, maintains a truly remarkable staff of linguists who spend all their time on this work alone. Three impressive results of their work are (1) abstracts, (2) indexes, and (3) book reviews.

Abstract sections are necessary not only in the weekly *Journal of the American Medical Association* but also in the nine monthly specialty journals. The weekly and each of the monthlies carry book reviews also. A most impressive achievement is represented by the *Quarterly Cumulative Index Medicus*. None of this activity, from book reviewing to

indexing, can be allowed to degenerate into indiscriminate mass-production. Because of the enormous number of books and periodicals to be covered, a great deal of unsuitable material has to be systematically excluded. Questions as to material of uncertain usefulness have to be settled constantly by people who combine a knowledge of languages, of medicine, and of scientific methodology.

Similar work, on a large scale or small, has to be carried out by every society that undertakes to keep its membership informed about progress in other countries, just as the valuable sections on abstracts and book reviews are maintained in the *Archives of Physical Medicine and Rehabilitation*. Dr. Coulter appreciated these facts, and was responsible, directly or indirectly, over a long period of years, for the abstracts that appeared in the *Archives*.

It is instructive to note some recent developments in this direction. Some countries are bilingual to start with. An example is Canada, where the *Canadian Medical Journal* publishes important material in both English and French; another is South Africa, where the journals have to publish in both English and Dutch. The *South African Medical Journal* prints the editorials in English and Dutch in two parallel columns. Especially striking is the *Hebrew Medical Journal*; it prints important materials in both English and classical Hebrew, but it takes advantage of the contrary directions of reading and pagination of the two languages, so that the reader can take either side of the cover as the front or the back, and can count pages from "front" or "back," as he wishes.

The extent to which foreign periodicals exert themselves to cross international linguistic barriers is remarkable. The *Bulletin of the Ophthalmological Society of Egypt* concludes each article with summaries in Arabic, English, and French. The *Archivio E. Maragliano di Patologia e Clinica* uses Italian for the substance of each article but follows with abstracts in Italian, French, English, German, and Spanish. The *Deutsche Medizinische Wochenschrift* has a section of summaries in German, English,

and Spanish. An especially remarkable phenomenon has been the appearance, within the past year, of the German Medical Journal. It is a monthly made up of the choicest articles out of the Deutsche Medizinische Wochenschrift, entirely in English.

American medical periodicals have been following various policies. Some have to reckon with the xenoglossophobia—the distrust of foreign languages—of the average reader or for other reasons appear to remain smug in their provincialism, and make few concessions to possible foreign readers. If the writer of an article is inarticulate or inexperienced, and concludes his article with a vague summary like "The acute abdomen has been discussed," the foreign reader is left to make out of it what he can. Much depends on the purpose of the publication. Journals whose purpose it is to make the results of research available to scientific investigators in other countries now supply the reader with an especially prepared abstract that summarizes the new facts and lends itself to translation. Some journals add a translation into one or more important languages. For instance, the American Review of Tuberculosis and Pulmonary Diseases gives summaries in Spanish, French, and German. The Journal of the International College of Surgeons uses German, French, and Italian.

The possibility exists—already realized to some extent—of greatly reducing the labor involved in all this translation. A new medium of communication in science has been developed, a Latin without inflections, called Interlingua. Based on words chosen so that they will be recognized by the largest possible number of people, it can be read with surprising ease by any educated person in Europe or the Americas. Seventeen medical periodicals now use Interlingua as the second language for their summaries.

The following example is a summary of the article by Neu, Harold N., and Ladwig, Harold A.: The Problem of the Long-Term Respirator Patient. Arch. Phys. Med. & Rehab. 37:351 (June) 1956:

Fifty patients who were dependent

on respirators following poliomyelitis were studied after admission to a regional respirator center. The onset of their acute poliomyelitis had occurred from 14 days to 8 years before admission to the center; they were brought by airplane, ambulance or train and were using a respiratory aid at the time of admission. Vital capacities varied from 900 cc. down to figures too low to be recorded. It has been possible to free every one of these patients from dependence on a tank respirator by weaning them to less cumbersome respiratory aids. These usually consist of a rocking bed at night and a chest respirator during the day. Independence from any type of respirator has been achieved in 12 patients.

The following translation into Interlingua was kindly supplied by Dr. Alexander Gode:

Cinquanta patientes—omnes dependente de respiratores in consequentia de poliomyelitis—esseeva studiate post lor admission a un centro respiratori regional. Le declaration del poliomyelitis acute habeva occurrite inter 14 dies e 8 annos ante le admission al centro. Le patientes habeva essite apportate per aeroplano, ambulancia, or traino. Al tempore de lor admission illes habeva usate adjutas respiratori. Lor capacitates vital habeva variate ab un maximo de 900 cm³ usque a un minimo infra le limites registrabile. Il ha essite possibile emancipar omne iste patientes ab lor dependentia de respiratores a tank per trans-accostumar les a minus ponderose adjutas respiratori. Istos consisteva usualmente de un lecto basculante durante le nocte e de un respirator thoracic durante le die. Independentia de omne genere de respirator esseeva effectuate in 12 patientes.

It is to be hoped that the use of Interlingua in this way will spread rapidly. It is one development in the rapidly evolving science of communication theory. An astonishing amount of research, fostered by the Bell Telephone Laboratories and many similar organizations, is being carried on in that field.

It has gone far beyond any petty tinkering with the hopeless system of English spelling. The amount of fundamental work being done by psychologists, physicists, and mathematicians on sounds and noises, on signs and signals, on binal arithmetic and Boolean algebra, on semantics and symbolic logic, is almost beyond the ability of one mind to comprehend.

But it is desirable that physicians and medical scientists should be aware of this work. We should be prepared to adapt the new resources to the promulgation of

our own technical discoveries. We should also be prepared to encourage anything that will facilitate the exchange of information generally, help to clarify human thinking, and otherwise accelerate our progress toward better ways of life. The medical publications of the United States should cooperate in these efforts as an expression of good will and a means of contributing to world peace.

Reference

1. Hansson, K. G.: The First John Stanley Coulter Memorial Lecture. *Arch. Phys. Med.* 32:628 (Oct.) 1951.

Courses in PT and OT

The School of Auxiliary Medical Services of the University of Pennsylvania announces special courses for graduate physical and occupational therapists to be given by the Division of Physical Therapy and the Philadelphia School of Occupational Therapy. The programs of study will be aided by a grant from the U. S. Office of Vocational Rehabilitation.

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Overwork

G. Clinton Knowlton, Ph.D.

and

Robert L. Bennett, M.D.

Warm Springs, Ga.

In most individuals, exercise gives a training effect that is evidenced by continuing, but decreasing, increments of skill, strength, and endurance as exercise is continued from day to day. This is so well recognized as to require no documentation. There seems to be less general appreciation of the long recognized fact that exercise, beyond a certain degree of load and repetition, can result in a long-lasting decrement of performance. Physiologists have labeled such a result of exercise variously as overfatigue, accumulating fatigue, and over-exercise.^{1, 2} Clinical reports have pointed to a "generalized neuromuscular exhaustion syndrome."³

Our particular interest in this subject is in relation to the effects of overwork on specific muscles, especially muscles that have been weakened as the result of anterior poliomyelitis. Exercise is probably the therapeutic device of greatest use in the re-education of such muscles. The specific exercise prescription is derived from a consideration of many factors about the individual and his handicap, but the basic goal is to develop skill, strength, and endurance in voluntary movement. Skill is developed by repetitive, coordinate exercise and, when acquired, of itself gives an increased usability to the basic strength. Increase of strength is best obtained by exercise at or near the maximal muscle strength. Endurance is the consequence of skill and strength of movement. Several pertinent questions appear with regard to such therapy. Must the exercise be limited in any other way than by the subjective feeling of the patient? Should the patient be given any special directions with regard to his activity level when he is ready to leave the direct supervision of the physician? In short, what is his status with regard to the possibility of overwork?

Actually, the unusual susceptibility to overwork of the muscles of persons just

recovering from acute poliomyelitis was delineated 40 years ago.⁴ Experimental confirmation that recovery from nerve trauma paresis can be delayed by injudicious exercise has been given.⁵ Thus many observations point to the need for some prudence in the prescription of exercise for such patients; their exercise tolerance is best obtained from a study of each individual.

Our own experiences have lead to the conclusion that an individual who has had poliomyelitis will be abnormally sensitive to overwork well beyond the immediate period after illness. Furthermore, the poliomyelitis victim is not unique in this respect since the muscles of anyone can be weakened by continued overwork.

Illustrative of what we mean by overwork is the instance of a 12-year-old boy who suffered an attack of anterior poliomyelitis in July, 1945. He was admitted to the Georgia Warm Springs Foundation in August, 1945. At that time he had moderate to severe weakness of the right lower extremity which responded so well to treatment that he was dismissed on a home routine in October, 1945. At this time his right gastrocnemius was graded P+ and on this leg he had a short brace with an anterior stop and a posterior wedge. By June, 1946, since he could come up onto right tip-toe five times, the brace was discontinued. Exercise was still limited by specific order as the child had athletic inclinations and desired to participate in some of his school's sports programs. By October, 1946 he could come up onto tip-toe ten times with ease. In June, 1947 he was again seen in the outpatient clinic when he appeared as a well-developed 14-year-old, walking without a limp and able to come up on tip-toe ten times easily. The only residual weakness was in the right

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peroneals, which were graded G+. This individual presented himself again as an outpatient in November, 1952 complaining of weakness in the right leg. Examination revealed that the gastrocnemius was now at P+ and the peroneals F+ on the right. The intervening history was that he had remained at his 1947 level through 1949 when, as a college freshman, his athletic desires had overwhelmed him and he went out for football and tennis. By the summer of 1950 he noticed that his right leg was getting weaker, which only spurred him to greater effort to "get in shape." This unwitting application of the therapeutically dangerous doctrine of "try to do more than you can, so you can do more" culminated in his 1952 visit, with a lower right extremity now returned to the strength level that it had had 7 years before, 3 months after recovery from poliomyelitis. Unfortunately, recovery from overwork was neither as rapid nor as complete as it had been from the initial poliomyelitis injury. This patient represents, to us, a characteristic instance of the effect of continued overwork upon a specific muscle group. He also represents the classic instance in which overwork is most likely to occur, that is, where the motivation for improved performance is so great that all subjective symptoms that would be expected to dictate decreased activity are ignored.

Such incidents are not common in our patient population. A survey of 246 patient histories, taken at random, yielded five individuals who showed a significant decrease in muscle strength. Of these, one is excluded because he later developed amyotrophic lateral sclerosis. The remaining four (incidence 1.6%) histories, including the one discussed in detail previously, all gave strong presumptive evidence of overwork coinciding with the decrease in strength. They are summarized in table 1.

In this survey we have ignored all instances of decreases in strength that were slight, equivocal, or of no consequence to the capability level of the individual. The four cited all had strength decrements that represented a drop from independent function to dependency in the sense that bracing had

to be instituted on a previously brace-free individual.

Shorter-lasting and less severe muscle strength decrements have been inadvertently produced in supervised exercise. A group of patients was given an exercise in which they lifted a load equal to one-half their maximal strength at the rate of one lift per second. The exercise was terminated either by the patient on a voluntary basis of feeling tired (subjective fatigue) or by an observer on the basis that the lifts could not be continued in rhythm with the metronome (objective fatigue). The test muscle was the biceps brachialis; the observations were being made for a purpose other than overwork. Most of the individuals had but one session of such exercise.

Our first clue that work of this intensity could result in strength decrements of significant duration was when some of the therapists reported loss of strength in the test muscles of certain of the patients. Because we were not convinced that there was a causal relation between the loss of strength and the exercise in these individuals, a more severe exercise was given one male adult patient. His right biceps brachialis had progressed, under a conservative regime, from a grade of P in October to a grade of F+ the following April. In June of that year he was able to lift, including arm weight, 40 ounces. At this time he made repetitive lifts carrying a total load of 32 ounces to subjective fatigue, which occurred after 26 lifts. After a rest of 15 minutes he was unable to lift his arm but made another exercise performance attempting to lift his arm at the metronome rate. Subjective fatigue terminated this work session after 25 attempted lifts. One week after these work sessions the subject could lift his arm only three times at the established work rate. In 2 weeks there was still no improvement. After 8 months the muscle strength had recovered to 43 ounces, only 3 ounces better than it had been before the test exercise 8 months before.

All of these incidents indicate that the muscles of persons who have had poliomyelitis does have a definite susceptibility to overwork. In such susceptible individ-

Table 1: Summary of Overwork in Four Post-Poliomyelitis Patients

Patient		Years after Acute Poliomyelitis	Activity Leading to Overwork	Muscle Group Injured	Duration of Overwork Activity, Yrs.
Age, Yrs.	Sex				
16	M	4	Athletics	Triceps surae	1
28	M	23	Business load	Triceps surae	4
26	M	5	Army duty	Triceps surae	2
34	F	2	Housework	Opponens pollicis	1½

uals, subjective fatigue is not an adequate safeguard against overwork. The overwork itself is most likely to occur as the result of a series of work sessions carried on from day to day at such a level and at such time intervals that adequate recovery cannot occur in the intervening rest periods. This means then that activity for these individuals must be prescribed on the basis of a careful medical evaluation and cannot be limited simply by the individuals' subjective sensations. Also, it means that such individuals must be given careful instructions with regard to their activity level after they leave the immediate supervision of the physician and they must be convinced that they have a certain safe level of activity within which they must operate.

Unfortunately, it is not only the muscle injured by poliomyelitis that is susceptible to overwork. Typical instances of the work injury of muscle not affected by poliomyelitis are offered in the almost identical histories of two patients, both of whom had had traumatic cord injury as a result of diving into shallow water. Two young men, one 16 the other 19 years of age, had each lost voluntary control of the finger flexors of one hand, but both had good wrist extensors in that arm so that an apparatus was made that enabled them to convert the power of the wrist extensors into finger flexion. The apparatus worked well and the patients were happy with it for a while, but only for a while. About 2 weeks after starting to use the device they both complained that it did not work well anymore because their wrist extensors were now too weak for the job. Thus two more muscles had been brought to a non-functional level by overwork. This in-

dicates that whenever a muscle is to be transferred to a new task, either by transplant or by apparatus linkage, the tolerable activity level of the muscle should be assayed against the work intensity of the new duties before the transfer is made.

Thus we conclude that there is a definite hazard to voluntary skeletal muscle from overwork. This arises from the fact that subjective fatigue, in the face of high motivation, is not a reliable safeguard against overwork. Therefore, in supervised exercise, the supervisor must be alert to the objective signs of fatigue and watch the day-to-day performance carefully in order to detect any muscle strength decrement that would indicate overwork. Preparation of the patient for the post-therapeutic period should include thorough indoctrination with regard to the possible effects if a continued activity load beyond the exercise tolerance is attempted.

References

1. Maison, G. L.: Failure of Gelatin or Aminoacetic Acid to Increase the Work Ability of Individual Normal Human Muscles. *J.A.M.A.* 115:1439 (Oct. 26) 1940.
2. Dawson, P. M.: *The Physiology of Physical Education for Physical Educators and Their Pupils*, Baltimore, The Williams and Wilkins Company, 1935.
3. Neilsen, J. M.: A Subacute Generalized Neuromuscular Exhaustion Syndrome. *J.A.M.A.* 126:801 (Nov. 25) 1944.
4. Lovett, R. W.: The Treatment of Infantile Paralysis. *J.A.M.A.* 64:2118 (June 26) 1915.
5. Lundervold, A., and Seyffarth, H.: Electromyographic Investigations of Poliomyelitis Paresis During the Training Up of the Affected Muscles and Some Remarks Regarding the Treatment of Paretic Muscles. *Acta psychiat. et neurol.* 17:69, 1942.

Comparison of Effects of Electric Stimulation with Effects of Intermittent Compression on the Work Output and Endurance of Denervated Muscle

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In previous reports it was demonstrated that electric stimulation improves the work output and endurance of denervated muscle and retards, but does not completely prevent, the course of denervation atrophy.^{1, 2} The circulation to the stimulated extremity was maximally increased by a stimulation frequency in the range of 8 to 32 impulses per second; 16 impulses per second were considered optimal for increasing blood flow.³ Electric stimulation of the denervated extremity for 5 minutes or more every half hour throughout the 8-hour day gave an average work output of the denervated stimulated muscle that was 40 to 52 per cent of the output of the normal intact muscle.¹

In the present study the effects of electric stimulation were compared with the effects of intermittent mechanical compression of denervated muscle in order to ascertain whether the favorable effects of electric stimulation could be attributed to the mechanical effects of intermittent contraction and relaxation induced by stimulation.

Methods

Adult male albino rats weighing about 250 gm. were used in this study. The animals were divided into five groups of approximately equal numbers. Group 1 consisted of rats that did not undergo denervation and were kept under the same kennel conditions as normal controls. Group 2 consisted of rats that underwent denervation, as described previously,¹ by excision of the sciatic and femoral nerves of one leg at the base of the thigh. Following denervation the paralyzed leg of each animal was electrically stimulated 15 minutes every half

hour, throughout the 8-hour day, at a frequency of 16 impulses per second. The same electric stimulator described previously¹ was used in this study. Group 3 consisted of rats that underwent denervation and were stimulated under the same conditions as in group 2 except that the frequency of stimulation was 1 impulse per second instead of 16 impulses per second. Group 4 consisted of rats that underwent denervation as in groups 2 and 3 but the paralyzed leg, exclusive of the paw, was intermittently compressed once every second for 15 minutes every half hour throughout the 8-hour day. A special cast of gauze hardened with collodion was made to fit loosely over the paralyzed extremity of each rat in group 4. The inner lining of the cast was made of a coil of thin Penrose drainage tubing, the top end of which was blind and the lower end of which was connected to a small artificial respirator that intermittently filled the tubing with air at a pressure of 280 mm. of mercury, as gaged by an aneroid manometer, and then released the air regularly once every second. This intermittently compressed the paralyzed leg mechanically once every second for 15 minutes each half hour throughout the 8-hour day. Group 5 consisted of rats that underwent denervation but that were not treated in any manner.

After 25 to 30 days of the described daily treatment, each rat of each group was anesthetized with intraperitoneally administered pentobarbital sodium, 30 mg. per kilogram of body weight. The

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The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota.

gastrocnemius-soleus-plantaris muscles at their tendo achillis attachment were exposed and the tendon was separated from its insertion. The animals were placed separately on the work-output machine as described previously.¹ The initial and total output of work and the endurance of each animal were measured and compared with those of normal litter mates under identical conditions.

Results

The findings in this study provide evidence for an attempt at assessing the importance of intermittent mechanical compression on the output of work and the endurance of denervated muscle. The initial and average total output of work with the standard error of the mean for the various groups of animals used in this study are given in the table. The output of work was also calculated for each group in percentage of that of the intact undenervated control group, which was considered to be 100 per cent. It is clearly demonstrated in the table that the work output of the muscles given intermittent mechanical compression once per second for 15 minutes every half hour through the 8-hour day was practically the same as or even slightly less than the work output of denervated muscles that were given no electric treatment at all during that period. The data clearly indicate that intermittent mechanical compression once a second did not improve the work output of denervated muscle. In a study on the influence of massage in patients with flaccid paralysis, a moderately consistent and definite increase in circulation was observed after

deep stroking and kneading massage of such extremities.⁴

The figure presents these effects graphically. The findings again show that electric stimulation at a frequency of 16 impulses per second has far more favorable effects on denervated muscle than it does at 1 impulse per second — a finding that was reported previously.⁵ The average total work output of the muscles stimulated at a frequency of 16 impulses per second was 59.2 per cent of that of the normal controls, while that of the muscles stimulated at a frequency of 1 impulse per second was only 31.9 per cent of the output of the normal controls.

If the effects of intermittent mechanical compression and decompression of denervated muscle could be considered similar to or could be compared with the contraction and relaxation induced by electric stimulation, the beneficial effects of the latter cannot be attributed to such contraction and relaxation. Factors other than mere compression and decompression must contribute to the improvement in work output and endurance resulting from electric stimulation of denervated muscle.

Summary

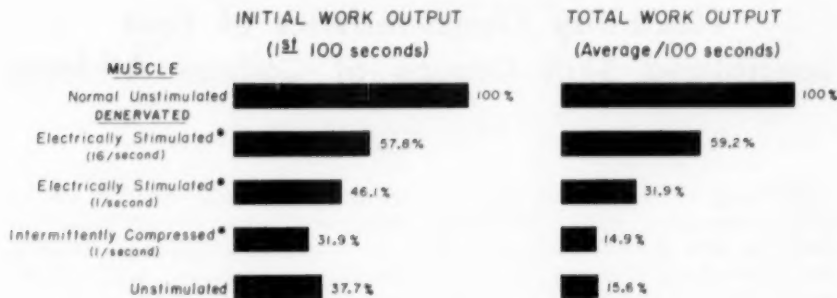
A comparison of the effects of electric stimulation with the effects of intermittent mechanical compression applied to denervated muscle for 15 minutes every half hour throughout the 8-hour day revealed that electric stimulation improved the work output and endurance of experimentally denervated muscle, while intermittent mechanical compression did not. The beneficial effects of

Comparison of Effects of Electric Stimulation with Effects of Mechanical Compression on Work Output and Endurance of Denervated Muscle of Rats

Group	Condition	No. Animals	Work Output, Gram-Meters per 100 Seconds			
			Output First 100 Seconds*	% of Normal	Average Total Output*	% of Normal
1	Controls Intact, undenervated	19	236.7 ± 13.2	100	192.1 ± 16.2	100
2	Denervated† Electric stimulation, 16/sec.	21	136.7 ± 18.5	57.8	113.7 ± 15.5	59.2
3	Electric stimulation, 1/sec.	29	109.1 ± 9.9	46.1	61.2 ± 12.3	31.9
4	Intermittent compression, 1/sec.	27	75.6 ± 5.7	31.9	28.6 ± 3.7	14.9
5	No treatment	19	89.3 ± 8.0	37.7	30.0 ± 4.0	15.6

* The value following the ± is the standard error of the mean.

† Treatment was given for 15 minutes every half hour throughout the 8-hour day.



* 15 minutes each half-hour or 240 minutes during the 8 hour day

Influence of denervation and stimulation on work output of skeletal muscle in percentage of output of normal muscle.

electric stimulation may be attributable to factors other than simple compression and decompression induced by the contraction and relaxation resulting from electric stimulation.

References

1. Wakim, K. G., and Krusen, F. H.: The Influence of Electrical Stimulation on the Work Output and Endurance of Denervated Muscle. *Arch. Phys. Med. & Rehab.* 36:370 (June) 1955.
2. Shaffer, D. V.; Branes, G. K.; Wakim, K. G.; Sayre, G. P., and Krusen, F. H.: The Influence of Electric Stimulation on the Course of Denervation Atrophy. *Arch. Phys. Med. & Rehab.* 35:491 (Aug.) 1954.
3. Wakim, K. G.: Influence of Frequency of Muscle Stimulation on Circulation in the Stimulated Extremity. *Arch. Phys. Med. & Rehab.* 34:291 (May) 1953.
4. Wakim, K. G.; Martin, G. M.; Terrier, J. C.; Elkins, E. C., and Krusen, F. H.: The Effects of Massage on the Circulation in Normal and Paralyzed Extremities. *Arch. Phys. Med.* 30:135 (Mar.) 1949.
5. Wakim, K. G.: Comparative Effects of Intermittent Compression and of Electric Stimulation on Denervation Atrophy. *Fed. Proc.* 15:195 (Mar.) 1956.

IMPORTANT ANNOUNCEMENT

American Board of Physical Medicine and Rehabilitation

The next examinations for the American Board of Physical Medicine and Rehabilitation will be held in New York City, June 8 and 9, 1957. The final date for filing applications is March 1, 1957. Applications for eligibility to the examinations should be mailed to the Secretary, Dr. Earl C. Elkins, 200 First St., S. W., Rochester, Minn.

Flexibility Characteristics of Four Specialized Skill Groups of College Athletes

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The study of flexibility or range of joint movement as an element of physical fitness has been given new impetus with the advent of the President's Conference on the Fitness of American Youth. This conference came into being partially as a result of the published findings of the Kraus-Hirschland study¹ on the fitness of American Youth as compared with European Youth. American youths were found to lack flexibility. As an important factor of rehabilitation a knowledge of flexibility characteristics has become the concern of specialists in physical medicine rehabilitation programs.

Studies of flexibility have resulted in establishment of clearer nomenclature, in better methods of measurement, and in better definition of the field of flexibility and its problems. Summaries of the studies and articles important to the field may be found in Wiehac and Krusen,² Cureton,³ and Salter.⁴

The purpose of this study was to make a preliminary investigation of specialized flexibility characteristics that accompany or are characteristic of specialized skills or specialized movements. Specifically, this is an investigation of the flexibility performance of men skilled in four different activities to find what variations may be present and to find possible leads for further investigation.

Procedure

The groups selected for measurement were all in training for competitive participation in sports at the college level. Further basis of selection was as follows:

1. 100 baseball players from six colleges in Washington and Oregon. The minimum requirement was that a subject had earned at least one letter for participation in college baseball.

2. 100 basketball players from four colleges in the state of Oregon. Minimum requirements were at least two varsity letters in high school and the equivalent

of either a freshman letter or one or more years of varsity competition.

3. 50 swimmers from four colleges in Oregon and California. Minimum requirements were at least 2 years competition in high school.

4. 44 shot putters and discus throwers from eleven colleges in Washington, Oregon and California. Selection was limited to those who had thrown the discus 120 feet or farther, who had put the 16-pound shot 40 feet or more, and who were right-handed. This group will be referred to as track men hereafter in this study.

These criteria were applied in an effort to make certain that the men being tested had participated in training for their particular activity long enough to allow for structural changes that might occur in or affect the joints, if such changes do occur as the result of intensified participation in specialized sports. The number of subjects in each case represents the total number available under normal conditions of attendance at or absence from the training program at the time measurements were taken. The problem of accurate sampling of subjects from among all college athletes meeting these criteria could not be met because of their wide distribution and the difficulty of controlling measurement. The groups measured, however, may be considered to be representative in that competition in these activities and rules and records are standardized thus subjecting all men to the same type of performance requirements in each activity.

All subjects were measured at room temperature, 72 F.; in no instance was a subject allowed to perform any exercise or activity before the measurements were taken. Time for relaxation and adjustment to room temperature was provided. The instrument used was the "Leighton

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Table 1: Flexibility Means of Specialized Skill Groups and of Sixteen-Year-Old California Boys for Tests Used in Studying Flexibility

Test	16-Yr.-Old M	Swimming M	Baseball M	Basketball M	Track M
Neck					
Flexion-extension	123.40	147.18	142.30	143.66	137.50
Lateral flexion	88.40	115.86	109.18	99.78	108.70
Rotation	158.40	185.30	185.00	187.82	182.16
Shoulder, right					
Flexion-extension	257.50	223.42	220.75	198.50	207.70
Shoulder, left					
Flexion-extension	257.70	223.74	223.69	206.30	211.80
Shoulder, right					
Adduction-abduction	173.20	199.40	187.55	160.54	171.70
Shoulder, left					
Adduction-abduction	173.20	197.20	191.10	161.40	175.80
Shoulder, right					
Rotation	170.40	199.50	195.35	187.00	201.08
Shoulder, left					
Rotation	170.90	198.60	193.40	183.30	206.75
Elbow, right					
Flexion-extension	141.10	143.02	156.50	150.94	150.88
Elbow, left					
Flexion-extension	142.70	163.54	156.85	152.10	152.58
Radial-ulnar, right					
Supination-pronation	161.90	191.40	200.05	180.40	174.60
Radial-ulnar, left					
Supination-pronation	161.50	196.30	197.70	180.90	185.12
Wrist, right					
Flexion-extension	130.10	167.80	142.25	127.22	161.90
Wrist, left					
Flexion-extension	131.70	167.66	141.50	127.96	161.14
Wrist, right					
Ulnar-radial flexion	75.50	83.20	96.50	87.72	82.50
Wrist, left					
Ulnar-radial flexion	75.90	83.26	94.65	84.30	86.27
Hip					
Extension-flexion	55.50	107.10	100.96	105.16	110.06
Adduction-abduction	63.30	55.88	56.39	55.16	53.00
Hip, right					
Rotation	68.60	107.62	112.80	87.86	85.75
Hip, left					
Rotation	70.00	105.02	109.65	84.20	87.70
Knee, right					
Flexion-extension	136.00	149.24	143.17	128.29	137.69
Knee, left					
Flexion-extension	135.90	150.38	142.41	125.89	137.44
Ankle, right					
Flexion-extension	62.70	69.80	75.40	57.66	55.60
Ankle, left					
Flexion-extension	62.80	70.08	71.54	58.44	55.44
Ankle, right					
Inversion-eversion	43.12	68.34	58.30	47.06	47.58
Ankle, left					
Inversion-eversion	43.60	62.40	58.75	45.66	45.78
Trunk					
Extension-flexion*	78.50	72.80	78.18	68.40	64.95
Lateral flexion	95.80	114.24	101.35	101.50	101.20
Rotation	128.60	137.34	136.62	122.74	118.43

*16-year-old Oregon group mean used for this test comparison as figures not available for California group.

Flexometer" and the technic of measurement was that previously reported.⁵ Reliabilities of the tests for these four groups ranged between 0.860 and 0.999.

Analysis of Data

In analysis of data, the differences between flexibility means of different skill groups can be studied. Such a study will show the difference of ability between these groups, if present, but not the importance of these differences, since performance criteria have not yet been established for any group.

In a previous study,⁵ evidence was found that flexibility is an age level characteristic among boys, and that cer-

tain trends in flexibility exist. Evidence was also found that these trends carry through from age 10 to age 16 years but that they end at this latter age level. The means at this 16-year-old level were also found to be consistent for boys of two different localities. For these reasons the means of a 16-year-old California group are used as norms for comparison. In this study any difference between the means of the 16-year-old California group and of the specialized skill groups for any tests that fall within the one per cent level of confidence ($t = 2.58$) is considered as evidence of a specialized high or low performance ability for the specialized skill group.

Table 2: Standard Deviations for Specialized Skill Groups in the Tests Used in Studying Flexibility

Test	Swimming	Baseball	Basketball	Track
Neck				
Flexion-extension	18.75	17.50	15.95	13.56
Lateral flexion	21.37	19.20	18.50	13.08
Rotation	17.51	19.28	21.11	18.48
Shoulder, right				
Flexion-extension	14.95	16.34	16.31	17.00
Shoulder, left				
Flexion-extension	14.89	16.06	14.41	16.80
Shoulder, right				
Adduction-abduction	14.70	15.42	11.76	12.55
Shoulder, left				
Adduction-abduction	13.71	14.67	12.04	15.96
Shoulder, right				
Rotation	20.55	20.52	21.51	18.60
Shoulder, left				
Rotation	18.61	20.92	18.36	21.25
Elbow, right				
Flexion-extension	13.97	8.66	8.91	9.99
Elbow, left				
Flexion-extension	8.83	7.62	8.70	10.40
Radial-ulnar, right				
Supination-pronation	16.02	21.23	22.36	16.85
Radial-ulnar, left				
Supination-pronation	17.29	23.93	19.35	21.00
Wrist, right				
Flexion-extension	15.72	18.80	18.19	16.25
Wrist, left				
Flexion-extension	13.41	18.50	19.25	13.48
Wrist, right				
Ulnar-radial flexion	10.74	15.53	13.54	16.86
Wrist, left				
Ulnar-radial flexion	11.06	16.83	12.93	16.50
Hip				
Extension-flexion	18.91	20.38	17.07	18.90
Adduction-abduction	3.76	7.80	7.34	7.48
Hip, right				
Rotation	23.40	20.84	18.15	14.95
Hip, left				
Rotation	22.79	19.52	16.23	13.86
Knee, right				
Flexion-extension	8.71	9.13	8.86	8.55
Knee, left				
Flexion-extension	8.12	7.85	8.18	9.33
Ankle, right				
Flexion-extension	9.76	14.05	9.99	7.30
Ankle, left				
Flexion-extension	8.33	11.51	8.47	8.49
Ankle, right				
Inversion-eversion	14.41	13.33	11.57	12.76
Ankle, left				
Inversion-eversion	18.50	13.22	13.22	11.36
Trunk				
Extension-flexion	17.81	17.10	14.46	15.60
Lateral flexion	17.14	13.33	13.23	12.40
Rotation	35.02	25.67	22.47	33.12

Findings

Tables 1 and 2 are presented as the basic data from which the study is made. Comparisons and interpretations are made from table 3. Table 3 is not entirely clear unless reference is made to tables 1 and 2. Table 3 compares the performance of each skill group with the performance of the 16-year-old group in terms of the *t* values by which each skill group exceeded or fell below the performance of the 16-year-old group on each test. Since these *t* values are di-

rectly comparable between all groups for any one test, comparison of the performance of swimmers, for example, on any test is directly comparable with the performance of baseball men, track men, and basketball men on the same test. The positive and negative signs indicate where the sport groups exceed or are not equal to the performance of the 16-year-olds. These deviations found among the different special skill groups are presented as evidence that special flexibility performance abilities do accompany the

Table 3: Table of *t* Values of Differences Between Means and Direction of These Differences When Means of Specialized Skill Groups Are Compared With the Means* of the California Group of Sixteen-Year-Old Boys.

Test	16 Yr. & Swimming D t	16 Yr. & Baseball D t	16 Yr. & Basketball D t	16 Yr. & Track D t
Neck				
Flexion-extension	+ 7.47	+ 7.78	+ 8.70	+ 5.26
Lateral flexion	+ 8.27	+ 11.30	+ 4.64	+ 8.12
Rotation	+ 8.75	+ 10.17	+ 10.68	+ 7.11
Shoulder, right				
Flexion-extension	- 13.00	- 16.55	- 26.80	- 16.60
Shoulder, left				
Flexion-extension	- 13.14	- 15.71	- 25.18	- 15.71
Shoulder, right				
Adduction-abduction	+ 10.70	+ 7.28	- 7.81	- .51
Shoulder, left				
Adduction-abduction	+ 10.90	+ 8.87	- 6.41	+ .90
Shoulder, right				
Rotation	+ 7.87	+ 8.21	+ 5.84	+ 10.16
Shoulder, left				
Rotation	+ 8.55	+ 8.45	+ 4.77	+ 9.35
Elbow, right				
Flexion-extension	+ 9.56	+ 11.00	+ 6.93	+ 5.26
Elbow, left				
Flexion-extension	+ 13.48	+ 11.98	+ 7.52	+ 5.40
Radial-ulnar, right				
Supination-pronation	+ 10.42	+ 14.25	+ 6.59	+ 4.15
Radial-ulnar, left				
Supination-pronation	+ 12.39	+ 12.84	+ 7.89	+ 6.68
Wrist, right				
Flexion-extension	+ 12.53	+ 4.42	- 1.06	+ 9.97
Wrist, left				
Flexion-extension	+ 13.06	+ 3.63	- 1.96	+ 10.39
Wrist, right				
Ulnar-radial flexion	+ 3.73	+ 9.67	+ 6.33	+ 2.40
Wrist, left				
Ulnar-radial flexion	+ 3.41	+ 8.52	+ 4.29	+ 3.54
Hip				
Extension-flexion	+ 15.60	+ 16.21	+ 19.47	+ 15.77
Adduction-abduction	- 3.83	- 3.21	- 3.82	- 4.46
Hip, right				
Rotation	+ 10.25	+ 15.93	+ 7.46	+ 5.87
Hip, left				
Rotation	+ 9.24	+ 14.41	+ 5.83	+ 6.18
Knee, right				
Flexion-extension	+ 5.88	+ 3.43	+ 1.11	+ .74
Knee, left				
Flexion-extension	+ 7.28	+ 3.63	- .55	+ .72
Ankle, right				
Flexion-extension	+ 3.45	+ 6.09	- 2.77	- 3.78
Ankle, left				
Flexion-extension	+ 3.94	+ 4.80	- 2.64	- 3.85
Ankle, right				
Inversion-eversion	+ 10.61	+ 8.67	+ 2.42	+ 1.97
Ankle, left				
Inversion-eversion	+ 6.55	+ 8.42	+ 1.14	+ 1.03
Trunk				
Extension-flexion*	- 1.34	- .08	- 2.72	- 3.25
Lateral flexion	+ 5.59	+ 2.15	+ 2.22	+ 1.85
Rotation	+ 1.68	+ 2.75	- 2.40	- 1.94

*16-year-old Oregon group mean used for this test comparison as figures not available for California group.
D = Direction of deviation from 16-year-old mean.

degrees of specialized skill attained by the groups studied.

Swimmers showed a high flexibility performance ability on 25 of the 30 tests. They do not show this high ability on tests of shoulder flexion and extension, hip adduction and abduction, trunk flexion and extension, or on trunk rotation tests.

Baseball players also showed a high flexibility performance ability on 25 of the 30 tests, but not in all cases on the same tests as the swimmers. Like the swimmers they do not show this ability for the shoulder flexion and extension movement nor for the trunk movements.

Basketball players showed quite a different pattern of flexibility performance ability from those of the swimmers and the baseball men. They showed superior performance ability in only 14 of the 30 movements as against 25 for both swimmers and baseball men.

The track men did not show characteristic flexibility performance abilities similar to the swimmers and baseball men, but showed superior ability on 15 of the 30 tests, inferior ability on 6 of the remaining tests, and approximately the ability of the 16-year-old group on 9 of the tests.

These data present acceptable evidence that significant differences exist between means of characteristics of specialization in flexibility performance ability as follows. All specialized skill groups showed superior flexibility performance ability in neck movements that aid in extending peripheral vision, but low ability in shoulder flexion and extension. Ability in shoulder movements that have to do with rotation was high. In arm movements that involve the elbow and wrist ability varied from specialized to approximately that of the 16-year-old group. Highly specialized performance was noted in hip flexion-extension, and rotation for all groups, and a low specialized performance for all groups in hip adduction and abduction. In all ankle and trunk movements ability included high per-

formance specialization, no specialization, and low performance specialization.

These findings are presented as strong evidence that the number and kind of specialized flexibility performance abilities vary significantly among the different specialized skills studied, and that these variations do not occur for all movements nor for the same movements among the different special skill groups. These results seem to furnish leads to further important study such as the need for establishment of acceptable basic criteria with which individual performance can be compared, possible improvement of skills by direct attempt to modify individual flexibilities to conform to the patterns found present in the specialized group involved, possible difficulty of developing skill where too high a variation from the pattern of the specialized skill is present, analysis of characteristic flexibility performances in terms of the movements of the activity which involves them, and further clarification of flexibility pattern characteristics of many special skill groups including those presented here.

Measurements of the specialized skill groups were taken by Magnus Syverson, Elvin T. Williams, William L. Pickens, and Oscar Lemiere.

References

1. Kraus, H., and Hirschland, R. P.: Minimum Muscular Fitness Tests in School Children. *Res. Quart.* 25:178 (May) 1954.
2. Wiechec, F. J., and Krusen, F. H.: A New Method of Joint Measurement and a Review of the Literature. *Am. J. Surg.* 43:659 (Mar.) 1939.
3. Cureton, T. K.: Flexibility as an Aspect of Physical Fitness. *Res. Quart. (supp.)* 12:381 (May) 1941.
4. Salter, N.: Methods of Measurement of Muscle and Joint Function. *J. Bone & Joint Surg.* 37-B:474 (Aug.) 1955.
5. Leighton, J. R.: An Instrument and Technique for the Measurement of Range of Joint Motion. *Arch. Phys. Med. & Rehab.* 36:571 (Sept.) 1955.
6. Leighton, J. R.: Flexibility Characteristics of Males Ten to Eighteen Years of Age. *Arch. Phys. Med. & Rehab.* 37:494 (Aug.) 1956.

An Evaluation of Some Electrodiagnostic Methods: III. Electromyography

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This third and last article of a series on "An Evaluation of Some Electrodiagnostic Methods"^{1,2} is devoted to electromyography. A brief historical resumé is included as well as an outline of the physiologic basis of electromyography.

History

In 1791, Luigi Galvani observed that electric current was produced by muscular contraction. Sixty years later Schiff^{3,4} observed fibrillation in the denervated muscle of a dog's tongue 5 days after section of the hypoglossal nerve. This asynchronous contraction of single muscle fibers could be seen with the naked eye. Schiff also observed that this fibrillation ceased with atrophy of the muscle or with regeneration of the nerve. Rogowicz,⁵ and later Ricker,⁶ observed that fibrillation was a tremor in denervated muscle. Langley and Kato⁷ renewed the interest in the study of fibrillation.

The first early experimental work with electromyography was done by Adrian⁸ in 1925. Other experimental work followed rapidly.⁹⁻¹⁷ Extensive work both in research and in the clinical application of electromyography also has been done.¹⁸⁻²⁰

Types of Equipment

Various types of equipment have been employed in electromyography. The development of the coaxial or concentric needle electrode¹¹ made it possible to record the potential difference produced by a single motor unit or even a single muscle fiber. This electrode consists of a hypodermic needle into which a single insulated wire is inserted. The needle acts as one electrode; the wire, which is flush with the end of the needle, acts as the other. Weddell, Feinstein, and Pattle²¹ used this type of electrode.

Jasper^{22,23} used the unipolar electrode, which consists of an active electrode (a fine needle insulated to its point), a reference electrode (a percutaneous electrode), consisting of a copper plate placed at or near the point of the needle insertion, and a ground electrode, a copper plate attached to a limb of the patient and usually leading to a common ground with the machine.

Percutaneous electrodes alone can be used only when it is not necessary to investigate the motor unit or when an added recording of superficial portions of the muscle is desired.²⁴ These electrodes consist of two small metal discs about 5 mm. in diameter applied over the skin; electrode jelly is used for better electrical contact. The skin should be thoroughly cleansed with acetone prior to the application of the electrodes. An additional large electrode may be placed on the anterior chest wall and grounded to eliminate the electrocardiographic effect.

It is usually recommended that the patient be placed in a copper-screened room for all types of testing. This is to eliminate outside electrical interference which might be picked up by the electrodes acting as antennas.

The electrodes lead to a high-grade amplifier with a frequency response from 40 to 6000 cycles.²⁹ The amplifier is coupled to a cathode ray oscilloscope, across which the electrons move showing positive and negative potentials in a regulated sweep. The electrical poten-

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tials are transformed to audible sound and transmitted through a loud speaker. A short, relatively high-pitched click indicates a short impulse such as a fibrillation, while a louder, lower, thumping sound indicates potentials produced by normal motor unit activity. The equipment used usually has a built-in calibrator, an integrating meter, a volume control, a stimulator, and a microvolt meter.

Some form of permanent recording of the action potentials should be available. A tape recorder³⁵ can be attached directly to the apparatus to record the potential changes on a magnetic tape and is able to play back the pattern both on the oscilloscope and through the loud speaker. Reproduction of the oscilloscope patterns by pen writers formerly was unsatisfactory because of inertia; however, counter-balanced writers of considerable accuracy are now being used. A camera may be used to record various isolated patterns if desired.

It is very desirable to use a stimulator concurrently with the apparatus so that the irritability of the muscle and the location of the electrodes may be checked. Other equipment, such as multichannel units and electronic counters, is used primarily for research and is not necessary for average clinical use.

Physiologic Basis of Electromyography

The motor unit consisting of the anterior horn cell, its axon, and the muscle fibers innervated by it is the basic unit studied by electromyography. The nerve impulse is propagated along a nerve fiber by a wave of depolarization. The physicochemical reactions of the nerve cell that are responsible for this wave of excitation are not clearly understood; however, it is well known that, if electrodes lead off from that nerve to an amplifier and an oscilloscope, a spike potential will be seen passing over the screen with the passage of an impulse. In a single nerve fiber, the spike potential will not vary in height regardless of the strength or cause of the stimulus that sets in motion this series of events. It is an all or none phenomenon. Sub-threshold stimuli, electrotonus, thermal

changes, or chemical changes may affect the rate of propagation or the number of impulses but not the intensity of the individual spike.

Leading off from the entire nerve instead of from a fiber considerably alters the characteristics of the simple spike potential. Various nerve fibers have different rates of conduction. The changes brought about by electrotonus alter further the nature of the impulse in a given nerve fiber. When all of these spikes are being integrated at the point of the electrode take-off, the oscilloscope screen picture shows a series of monophasic, diphasic, triphasic and/or polyphasic spikes of various intensities.

In the intact human, even more complications arise because most impulses that cause voluntary muscle contractions are brought about by a volley of impulses set up either at the cord level or by the higher centers. This combined, effective, purposeful transmission of impulses leads to smooth muscular activity, with other synchronous, inhibitory activity taking place in the antagonistic muscles. All of these impulses produce spike potentials. These spike potentials are the object of study in electromyography. It can easily be seen that, without an adequate appreciation of all the factors contributing to the wave form of the spike potential, a superficial inspection could lead to an improper interpretation of the recording.

The application of the electrodes to muscle fibers compounds the number of variables contributing to the spike potentials, for the motor unit producing waves of excitation over all its fibers from the motor nerve adds electrical activity of its own in smaller, more numerous waves of depolarization. The cause, propagation, and character of the waves are no different than those produced by nerve tissue. They are affected by the same conditions that affect nerve tissue plus the added complications of the originating nerve impulse, the complex nature of transmission across the myoneural junction, and the circulatory and metabolic activity in the muscle tissue.

In healthy voluntary muscle, certain patterns are elicited by electromyographic

testing. With the insertion of the needle electrode, an outburst of electrical activity, designated by Weddell and his co-workers³⁰ as "insertion" motor unit action potentials, occurs. This activity subsides rapidly until none is produced at rest, provided the muscle being tested is relaxed. The insertion action potentials differ from the voluntary motor unit action potentials only in the method of production.

With slight voluntary contraction, normal motor-unit action potentials appear. These are very few in number and usually are repetitive at 5 to 10 per second. With increased tension, these potentials speed up; the average maximum rate is about 20 per second.³¹ As voluntary contraction increases in strength, more motor units are brought into play until eventually the entire sweep on the tube is disturbed. In most limb muscles, the range of maximum amplitude of the normal potentials is between 100 microvolts and 2 millivolts and they are of 5 to 10 milliseconds duration.³⁷ The average size of the potentials in limb musculature is greater than in facial muscles apparently because of the number of muscle fibers constituting each motor unit.²²

The usual form of the normal action potential is monophasic or diphasic, although triphasic potentials and occasionally polyphasic potentials are seen. Polyphasic patterns are sometimes simulated by pairs of diphasic or triphasic potentials firing in close approximation, but these will pass out of phase. Highly polyphasic potentials are usually indicative of reinnervation and may reveal the presence of very minor localized nerve damage that has healed.

In completely relaxed limb muscles, no electrical activity is recorded; however, if the person is overly apprehensive, complete silence is difficult to obtain. In certain trunk muscles, it is almost impossible to obtain complete relaxation. It has also been shown that it is impossible to obtain complete relaxation in the cervical musculature except for the trapezius.

In the study of denervated muscles, the most important single pathological

feature is the presence of fibrillation. Proebster⁹ and Denny-Brown and Pennybacker¹⁵ suggested that fibrillation activity was due to sensitization of the denervated muscle to small amounts of circulating acetylcholine. Marinacci²⁰ has made a detailed study of fibrillation. Essentially, the fibrillation action potential takes the form of monophasic or diphasic spikes 1 to 2 milliseconds in duration and up to 100 microvolts in amplitude. They usually occur at the rate of 2 to 10 per second. The sound produced is that of sharp clicks being repeated at a rapid rate. There is no relation to voluntary effort. Fibrillations are either of the insertion type, which occur with the mechanical stimulation by the electrode and gradually disappear, or of the spontaneous type, which have no relationship to needle movement and last indefinitely. They only disappear with fibrosis of the muscle or with regeneration of the nerve.

The approximate time of onset of fibrillation following nerve injury is 18 days in the human.³¹ The first few days after injury, action potentials are elicited by insertion of the needle. This gradually diminishes until about the 16th day when insertion-type fibrillation occurs. A few days later the insertion type is followed by the spontaneous type, which persists indefinitely. The onset of fibrillation is somewhat shorter in the trunk and face musculature.

Any interruption of the lower motor neuron will eventually give rise to fibrillation. The pathological condition may be in either the cord affecting the anterior horn cell or in the peripheral nerve. Fibrillation may be hard to find if the involvement is minor; consequently, numerous samplings are required. Partial denervation can be distinguished from total denervation by the finding of normal motor unit action potentials along with fibrillation, in the testing of multiple areas. The presence of fibrillation is dependent upon the condition of the muscle. The involved muscle must still have the ability to contract. Accordingly it can be stated that muscle fibers showing fibrillation are healthy and capable of contraction once regeneration of the

nerve fibers has taken place.²⁰ In a muscle that has been denervated and inactive for a long time, fibrillation gradually decreases as fibrosis increases.

The number and frequency of fibrillations are also affected by extrinsic factors.³⁷ Warming the muscle increases the fibrillation as does the injection of prostigmine. After physical therapy an increase is usually noted; on the other hand, splinting and cooling normally diminish the number and frequency of fibrillations.

Fasciculation is a term used to denote spontaneous contraction of a motor unit. When superficial units are involved, they can be seen by the naked eye. These spontaneous motor unit potentials are of two types, the slow sporadic discharges appearing at roughly regular intervals of 10 seconds to 2 minutes, and the fast rhythmic impulses at 8 to 10 per second.³⁴ The slow type is usually considered characteristic of motor neuron disease. There may be several or many fasciculating areas in close proximity. In the electromyograph, each twitch appears as a single spike of 5 to 10 milliseconds with an amplitude of 100 to 500 microvolts. The fasciculating motor unit is capable of voluntary contraction and its fasciculation is not abolished by contraction of the antagonist.¹⁵ It was formerly believed that the origin of fasciculation was in the anterior horn cell,¹⁵ but experiments with procaine infiltration of the motor nerve and nerve section cast doubt on this theory. Since fasciculation persists for 4 or 5 days after section of the nerve, the origin must be in the peripheral portion of the nerve fiber, in the myoneural junction, or in the muscle.³⁶⁻⁴² Slow fasciculations are usually associated with lower motor neuron disease, but may also be seen in smaller numbers in other types of lower motor neuron involvement.

Fast, rhythmic fasciculation indicates slight, involuntary muscular contraction.³⁴ This may be a psychogenic tenseness or a reflex reaction due to painful, postural, or other stimuli. Certain muscle groups in the face and neck rarely show complete relaxation. Fast fasciculation is of diagnostic value in such conditions as

disease of the lower motor neuron or spinal nerve root compression only if comparison with other muscle groups is made and all reflex or postural factors are carefully evaluated.⁴³⁻⁴⁶

Clinical Application of Electromyography

The greatest clinical value of electromyography at the present time is in the diagnosis, evaluation, and prognosis of peripheral nerve injury. Testing of multiple areas can usually inform the observer whether the lesion has produced a partial or complete (or nearly complete) severance of the motor nerve fibers by the presence or absence respectively of normal motor unit action potentials with fibrillation in the same muscle. The complete absence of fibrillation after the time required for its appearance indicates uncomplicated physiological block or hysterical paralysis. A progressive increase in fibrillation and decrease of normal motor unit action potentials indicates a progressive lesion.³⁷ The diagnostic value lies in the interpretation of findings as an aid to the surgeon in deciding if and when to attempt nerve suture, neurolysis, or other exploratory procedures.

Regeneration of a nerve fiber follows a definite electromyographic pattern.³⁶ Immediately after injury there is a loss of voluntary power. The electromyograph shows no motor unit action potentials with attempted voluntary contraction, unless the lesion is only partial. The ability to obtain the insertion burst remains for 14 to 21 days but gradually diminishes. At about this same time, insertion fibrillation appears. A few days later, no motor unit action potentials are seen at insertion but spontaneous continuous fibrillations are recorded after insertion. These continue either until recovery or fibrosis takes place. If recovery is anticipated (with or without surgery), the denervated muscles are tested at frequent intervals. Since axon regeneration varies between 1.5 to 2.5 mm. per day, sufficient time must be allowed before expecting changes. The first suggestive sign of recovery is a reduction or cessation of fibrillation; however, it must be established that active fibrillation

existed in the 2 or 3 weeks immediately prior to this. The first definite sign is the appearance of small polyphasic action potentials. These may last only a few seconds and frequently are difficult to distinguish from a burst of fibrillations; however, they do occur with attempted voluntary contraction. Usually about 10 days elapse before these potentials can be sustained.²⁹ At first the potentials appear at the motor point of the muscle and rapidly (2 to 4 weeks) spread throughout. Following these small polyphasic units, larger, highly polyphasic units appear. These are the typical motor units of regeneration. They are eventually replaced by the normal motor unit action potentials, but a few polyphasic units and even fibrillations may remain indefinitely. The appearance of motor unit action potentials precedes considerably the return of voluntary contraction (4 weeks to 7 months or more).²⁹ In assessing these findings, dual innervation must be considered, for there may be an overlapping nerve supply from adjacent uninjured nerves. The prognostic value lies in the close observation of this course of events; however, return of motor unit potentials does not always mean that a sufficient number will return to give normal voluntary function. If there is undue delay in evidence of recovery, further neurosurgical intervention may be necessary.

If there is no recovery, fibrillation remains as long as the denervated muscle fibers are capable of contraction. As fibrosis sets in, the fibrillations gradually decrease until there is complete electrical silence, indicating complete fibrosis. A few fibrillations, however, usually may be found many years afterwards.^{9, 31, 37}

The use of electromyography as an adjunct in the diagnosis of nerve root lesions has received considerable attention. Electromyography is able to verify the presence of such lesions by the finding of abnormal fibrillations and in addition may assist in locating the exact root or roots involved. Used in connection with myelograms, or alone where myelography would be difficult or refused, electromyography can be of considerable value in determining whether laminectomy is indicated.

In anterior poliomyelitis, electromyography can be helpful in both diagnosis and prognosis. Diagnostically, denervated activity is usually spotty and follows pleurisegmental distribution. In addition to fibrillation (after 21 days) polyphasic units are seen, which are indicative of altered nerve cell function.²⁹ After the acute phase of the disease has passed and the injured or physiologically blocked nerve cells are again functional, muscles which show large numbers of fibrillations and no or very few normal motor unit action potentials will usually not return to any degree of voluntary activity. Muscles with a larger number of normal action potentials will respond better to physical therapy as they stand a much better chance of partial or complete return. Later in the course of the disease "giant" motor unit potentials are occasionally seen. They are thought to be the result of muscle cell hypertrophy of the normal motor units.⁴⁷

In the various types of neuronitis, plexitis, and other neuropathies, the chief differential point in electromyographic diagnosis is that the denervation potentials increase in degree progressively from the proximal to the distal portion of the affected muscle group.²⁹ They are confined to the various muscle groups involved.

The various types of degenerative diseases of the spinal cord lend themselves well to early diagnosis by electromyography. Multiple sclerosis, amyotrophic lateral sclerosis, subacute combined cord degeneration, and progressive spinal muscular atrophy are all included in this group.^{29, 38-40} In general, these conditions show generalized fibrillation potentials that are of diagnostic importance. Early clinical signs may be limited to a few isolated muscles or muscle groups and may easily be confused with local neuropathy unless the electromyographic findings of fibrillation in other areas are present. Fasciculations are also frequently encountered and in the presence of fibrillations are considered evidence of lower motor neuron disease.

The electromyograph also is of diagnostic value in the muscular dystrophies. In these conditions, the lower motor neuron remains essentially intact; there-

fore, no fibrillations are expected. Instead, the pathological pattern is one of many, very small motor units during voluntary contraction. These dystrophic units are a wave form of tiny spikes with low amplitude and rapid frequency (up to 40 or more per second). The insertion burst is of normal duration but comprised of the same small spikes. During prolonged voluntary effort, the potentials decrease in rapidity indicating fatigability. Normal potentials may be seen, depending on the state of the involvement.²⁸

The different types of muscular wasting can be distinguished by electromyography. Neurogenic atrophy shows fibrillation and a small number of normal or large motor units. Primary muscular dystrophy, as previously described, shows the small, rapid, polyphasic potentials on voluntary effort, with no fibrillations.^{20, 29, 34} In atrophy of disuse, the tracings show no fibrillation but instead normal motor units action potentials, though they may be decreased in number.

The myotonias present a distinctive electromyographic picture. Immediately on insertion of the needle, there is an outburst of high frequency activity which gradually diminishes. The potentials become smaller until they resemble fibrillations and then gradually electrical silence ensues. This outburst may last up to a minute. During voluntary contractions, a dystrophic type of activity is seen. In the myotonias, the distinctive findings are muscular in origin.^{29, 48}

Another important use of electromyography is in the medicolegal evaluation of certain neuromuscular disability claims. There are many cases on record where claimed injuries or neurological disorders have been proved or disproved by electromyography.

Discussion

Electromyography has, or will have, a definite place in the field of medical instrumentation; however, early enthusiasm and eagerness to make clinical applications usually leads to exaggerated and unfounded claims for the efficacy of the method involved, which in turn leads to disappointment, discredit, and lack of

appreciation of the true clinical value of the procedure.

To prevent this unfortunate sequence, it is necessary for the clinician using the electromyograph to have a well-founded knowledge of basic physiology, pathophysiology, and anatomy of the neuromuscular system. In addition to this he must have a thorough knowledge of his instrument, including above all, its limitations. Through constant practice he must develop an approved standardized technic so that results will be reliable. His work must be thorough and complete with frequent rechecks and comparisons to previous testings. If the material is available, he should spend time studying patients with proved diagnosis to compare these findings with those on diagnostic problems. Finally, and most important, he should take great care not to read too much into his findings. In cases referred for testing, he should report objective findings only; the interpretation should be made by the referring service. The studies should be done in close correlation with all other available laboratory studies and the total results reviewed, rather than all emphasis being placed on electromyography to the exclusion of the other valuable diagnostic aids.

With an understanding of the basic principles of electromyography, it can be seen that at the present its most definitive use lies in the field of diagnosis and prognosis of peripheral nerve lesions. The presence or absence of fibrillation makes this possible. The most valuable use to the clinician is in the prognosis of these same peripheral nerve lesions. No other device or test can give the same definite information as early in the course of events as electromyography. Its use in the diagnosis and prognosis of other neuromuscular disorders is ever increasing, perhaps too rapidly, for much additional research still needs to be done to explain adequately many of the patterns seen in these conditions.

With the proper scientific approach, much can be learned from electromyography and valuable contributions to the growing mass of statistics can be made. Eventually certain clear-cut facts and

principles can be deduced from this evidence, but only if the basic principles of scientific research are adhered to.

One of the major drawbacks to the use of electromyography by the clinician is the amount of time consumed in testing a single patient. Add to this the original cost of the apparatus and the cost of testing in many cases would be prohibitive. This problem can be lessened to some degree by employing a trained technician to assist the doctor, thereby shortening the time required in preparing the patient and the apparatus.

In general, it seems that, in spite of the obvious advantages gained from intelligent use of electromyography, the average clinician does not have the time, nor the opportunity to perform this type of testing in sufficient quantity to be of benefit to him or the patient. The same information, although perhaps less accurate than that gained from electromyography, can be obtained from other means of testing that are easier and quicker to perform.^{1,2} At present, it is felt that electromyography should be a service offered in the larger clinics and teaching institutions where sufficient time and funds can be allotted to research and training necessary for its proper scientific use.

Summary

A brief resumé of the historical aspects of electromyography and early clinical research is given. The various types of apparatus used are briefly described. The physiologic basis for electromyography is discussed including nerve-muscle impulse propagation, the motor unit, the all or none theory, and the production of electrical changes with activity. The appearance of patterns from normal voluntary muscle is discussed, and comparison is made between these and the patterns formed in various neuromuscular disorders. The etiology and significance of fibrillations and fasciculations are discussed.

References

1. Boyle, R. W., and Dudenhofer, P. A.: An Evaluation of Some Electrodiagnostic Methods. I. Arch. Phys. Med. & Rehab. 37:422 (July) 1956.
2. Boyle, R. W., and Dudenhofer, P. A.: An Evaluation of Some Electrodiagnostic Methods. II. Low Voltage Testing. Arch. Phys. Med. & Rehab. 37:487 (Aug.) 1956.
3. Schiff, M.: Nachtrag zu dem Aufsatze über motorische Lahmung der Zunge. Arch. f. Physiol., Heilkunde 10:465, 1851.
4. Schiff, M.: Ueber Motorische Lahmung der Zunge. Arch. f. Physiol., Heilkunde 10:577, 1851.
5. Rogowicz, N.: Ueber Pseudomotorische Einwirkung der Una Vienssenii auf die Gesichtsmuskeln. Arch. f. d. ges. Physiol., Bonn 36:1, 1885.
6. Ricker, G.: Beiträge zur Lehre von der Atrophic und Hyperplasic. Arch. Path. Anat. 165:263, 1901.
7. Langley, J. N., and Kato, T.: The Physiological Action of Physostigmine and its Action on Denervated Skeletal Muscle. J. Physiol. 49:410, 1915.
8. Adrian, E. D.: Interpretation of the Electromyogram. Lancet 1:1229 (June 13) and 1:1282 (June 20) 1925.
9. Proebster, R.: Intramuskuläre Aktionsstromableitung nach intramuskulären Reizung. Eine neue Untersuchungseinrichtung für den Menschen. Klin. Wchnschr. 7:297 (Feb. 12) 1928.
10. Wachholder, K.: Willkürliche Haltung und Bewegung insbesondere im Lichte elektrophysiologischer Untersuchungen. Ergebn. d. Physiol. 26:568, 1928.
11. Adrian, E. D., and Bronk, D. W.: The Discharge of Impulses in Motor Nerve Fibres; the Frequency of Discharge in Reflex and Voluntary Contractions. J. Physiol. 67:119 (Mar.) 1929.
12. Pritchard, E. A. B.: The Electromyogram of Voluntary Movements in Man. Brain 53:344 (Oct.) 1930.
13. Lindsley, D. B.: Electrical Activity of Human Motor Units During Voluntary Contraction. Am. J. Physiol. 114:90 (Dec.) 1935.
14. Lindsley, D. B.: Electromyographic Studies of Neuromuscular Disorders. Arch. Neurol. & Psychiat. 36:128 (July) 1936.
15. Denny-Brown, D., and Pennybacker, J. B.: Fibrillation and Fasciculation in Voluntary Muscle. Brain 61:311 (Sept.) 1938.
16. Hofer, P. F. A., and Putnam, T. J.: Action Potentials of Muscles in Normal Subjects. Arch. Neurol. & Psychiat. 42:201 (Aug.) 1939.
17. Hofer, P. F. A.: Innervation and "Tonus" of Striated Muscle in Man. Arch. Neurol. & Psychiat. 46:947 (Dec.) 1941.
18. Eccles, J. C.: Changes in Muscles Produced by Nerve Degeneration. M. J. Australia 1:573 (May 10) 1941.

19. Buchthal, F., and Clemmesen, S.: On Differentiation of Palpable Muscle Affections by Electromyography. *Acta med. Scandinav.* 105:48, 1940.
20. Buchthal, F., and Clemmesen, S.: On Differentiation of Muscle Atrophy by Electromyography. *Acta psychiat. et neurol.* 16:143, 1941.
21. Buchthal, F., and Clemmesen, S.: The Electromyogram of Atrophic Muscles in Cases of Intramedullary Affections. *Acta psychiat. et neurol.* 18:377, 1943.
22. Buchthal, F.: Problems of the Pathologic Physiology of Poliomyelitis. *Am. J. Med.* 6:579 (May) 1949.
23. Golseth, J. G., and Fizzell, J. A.: Electromyographic Studies on Cats After Section and Suture of the Sciatic Nerve. *Am. J. Physiol.* 150:558 (Oct.) 1947.
24. Kugelberg, E.: Clinical Electromyography. *Progr. Neur. Psychiat.*, New York 8:264, 1953.
25. Peterson, I., and Kugelberg, E.: Duration and Form of Action Potential in Normal Human Muscle. *J. Neurol., Neurosurg. & Psychiat.* 12:124 (May) 1949.
26. Kugelberg, E., and Peterson, I.: "Insertion Activity" in Electromyography. *J. Neurol., Neurosurg. & Psychiat.* 12:268 (Nov.) 1949.
27. Denny-Brown, D.: Interpretation of the Electromyogram. *Arch. Neurol. & Psychiat.* 61:99 (Feb.) 1949.
28. Golseth, J. G., and Huddleston, O. L.: Electromyographic Diagnosis of Lower Motor Neuron Disease. *Arch. Phys. Med.* 30:495 (Aug.) 1949.
29. Marinacci, A. A.: Clinical Electromyography, Los Angeles, San Lucas Press, 1955.
30. Jones, R. V., Jr.; Lambert, E. H., and Sayre, A. P.: Source of a Type of "Insertion Activity" in Electromyography with Evaluation of a Histological Method of Localization. *Arch. Phys. Med. & Rehab.* 36:301 (May) 1955.
31. Weddell, G.; Feinstein, B., and Pattle, R. E.: The Electrical Activity of Voluntary Muscle in Man under Normal and Pathological Conditions. *Brain* 67:178 (Sept.) 1944.
32. Jasper, H. H.: Integration and Disintegration of Motor Units; Unipolar Electromyography in Neuromuscular Disease. *Fed. Proc.* 6:137 (Mar.) 1947.
33. Jasper, H. H., and Ballem, G.: Unipolar Electromyograms of Normal and Denervated Human Muscle. *J. Neurophysiol.* 12:231 (July) 1949.
34. Hirschberg, G. G., and Abramson, A. S.: Clinical Electromyography—Physiologic Basis, Instrumentation, Diagnostic Value. *Arch. Phys. Med.* 31:576 (Sept.) 1950.
35. Marinacci, A. A., and Golseth, J. G.: Clinical Myoscope. *Electroencephalog. & Clin. Neurophysiol.* 3:253, 1951.
36. Weddell, G.; Feinstein, B., and Pattle, R. E.: The Clinical Application of Electromyography. *Lancet* 1:236 (Feb. 20) 1943.
37. Bowden, R. F. M., in *Peripheral Nerve Injuries*, Medical Research Council Special Report Series No. 282, London, Her Majesty's Stationery Office, 1954, pt. 2, chap. 6.
38. Forster, F. M., and Alpers, B. J.: The Site of Origin of Fasciculations in Voluntary Muscle. *Arch. Neurol. & Psychiat.* 51:264 (Mar.) 1944.
39. Forster, F. M.; Borkowski, W. J., and Alpers, B. J.: Effects of Denervation on Fasciculations in Human Muscle; Relation of Fibrillations to Fasciculations. *Arch. Neurol. & Psychiat.* 56:276 (Sept.) 1946.
40. Swank, R. L., and Price, J. C.: Fascicular Muscle Twitchings in Amyotrophic Lateral Sclerosis; Their Origin. *Arch. Neurol. & Psychiat.* 49:22 (Jan.) 1943.
41. Hofer, P. F. A.: Electromyographic Study of the Motor System in Man. *Monatschr. f. Psychiat. u. Neurol.* 117:241, 1949.
42. Richardson, A. T.: Muscle Fasciculation. *Arch. Phys. Med. & Rehab.* 35:281 (May) 1954.
43. Brazier, M. A. B.; Watkins, A. L., and Schwab, R. S.: Electromyographic Studies of Muscle Dysfunction in Infectious Polyneuritis and in Poliomyelitis. *New England J. Med.* 230:185 (Feb. 17) 1944.
44. Buchthal, F., and Honcke, P.: Electromyographical Examination of Patients Suffering from Poliomyelitis (ant. ac.) Followed up to 6 Months After the Acute Stage of the Disease. *Acta med. Scandinav.* 116:148, 1944.
45. Brazier, M. A. B.; Watkins, A. L., and Michelsen, J. J.: Electromyography in Differential Diagnosis of Ruptured Cervical Disk. *Arch. Neurol. & Psychiat.* 56:651 (Dec.) 1946.
46. Hofer, P. F. A., and Guttman, S. A.: Electromyography as a Method for Determination of Level of Lesions in the Spinal Cord. *Arch. Neurol. & Psychiat.* 51:415 (May) 1944.
47. Van Harreveld, A.: Re-innervation of Denervated Muscle Fibers by Adjacent Functioning Motor Units. *Am. J. Physiol.* 144:477 (Sept.) 1945.
48. Shea, P. A.; Woods, W. W.; and Tratar, A. A.: The Myotonias, an Electromyographic Study, with Special Reference to Myotonia Acquisita. *Arch. Neurol. & Psychiat.* 68:794 (Dec.) 1952.

Fifty Years of Food and Drug Administration Protection With Special Relation to Medical Devices

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The purpose of this discussion is to trace the growth and changes in federal food and drug legislation since the passage of the Pure Food and Drug Law of 1906. Enforcement of this legislation was vested in the Bureau of Chemistry of the United States Department of Agriculture under the leadership of Dr. Harvey W. Wiley. For a half century the American public has had legislation aimed at insuring pure foods and drugs. This statute served to protect the public from foods dosed with harmful chemical preservatives, candy colored with poisonous dye, soothing narcotic syrups for babies, and the tragic consequences that followed reliance upon the cure-all promises of falsely labeled patent medicines.

The value of the public protection provided by the existing food and drug legislation and the need for a separate enforcement group led to the organization in 1927 of the Food and Drug Administration (FDA) as a separate unit to take over the regulatory functions formerly under the Bureau of Chemistry. With progressive leadership a new "pure food" law was drafted in 1933 and submitted to Congress. It was designed to furnish a more effective means to combat abuses that could not be controlled under existing legislation. Defects in the law itself were revealed in many court decisions; these needed to be remedied to provide fuller consumer protection. For the first time curative devices and cosmetics were included under federal control. In the original proposal the word "drug" was stretched to include devices. This original presentation was not enacted by Congress, but devices were specifically included in the bill enacted after 5 years of continued effort — the Federal Food, Drug, and Cosmetic Act of 1938.

Provisions of the Federal Food, Drug, and Cosmetic Act

The Federal Food, Drug, and Cosmetic Act brought devices under federal supervision in a manner almost parallel to that of drugs. Now there was a legal means to deal with devices falsely represented for a wide variety of diagnostic and therapeutic uses, as well as those units that may be dangerous to health when offered in interstate commerce.

The term "device" as defined in the Act means instruments, apparatus, and contrivances, including their components, parts and accessories, intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease in man or other animals, or intended to affect the structure or any function of the body of man or other animals.

The labeling requirements for devices are similar to those for drugs. Although the active ingredients are not required to be declared for devices, such articles must meet other labeling provisions. The responsibility for labeling to insure truthful, safe, and efficacious use of a device is solely that of the manufacturer or distributor. The Act provides that the labeling of a device must not be false or misleading in any particular; the label must carry the name and place of business of the responsible purveyor, whether manufacturer, packer or distributor; adequate directions for use; and adequate warnings against misuse; and the device must not be dangerous to health.

Exemption for Prescription Devices

It should be recognized that there is provision through regulations in the Act

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to exempt from adequate directions for use what may be termed "prescription devices." Such types of apparatus are set apart since their potentiality for harmful effect, method of use, or collateral measures necessary for use require the supervision of a practitioner licensed by law to direct their safe use. Thus, "adequate directions for use" by the layman cannot be prepared. This exemption is legal provided the device is offered for sale only to or on the prescription or order of the physician in his professional practice. The label (other than for surgical instruments) bears the statement: "Caution: Federal law restricts this device to sale by or on the order of a _____," the blank to be filled in with the word "physician," "dentist," "veterinarian," or other practitioner licensed by law of the state in which he practices. The labeling of the device must be readily available or information relating to its use is widely disseminated in scientific literature.

In the drafting of legislation on such devices, attention was also given to the possibility of a device being adulterated. This terminology may seem strange when applied to apparatus. Yet it is through this section of the Act, for example, that legal authority is established to proceed against clinical thermometers that fail to record accurately because of faulty construction.

As is readily apparent, the Act exacts a high level of responsibility. Manufacturers generally have accepted and carried out their obligations. Unfortunately, constant surveillance is required to deal with the active promotion of violative devices by a small part of the industry.

Legal Prohibitions

The Act is designed primarily in the interest of the health and welfare of the consumer. Violative articles may be seized, and the shipper may be prosecuted criminally or enjoined from further violations. When the responsible persons contest the Government's action, the case goes to trial. The Administration relies on the physician to present the scientific view of the case. Accordingly, whenever possible, experts in physical

medicine are employed who have personal experiences with the use of devices. Sometimes experts may be especially qualified through special studies conducted independently; in other instances, they conduct appropriate investigations on behalf of the Government.

The physician is in a unique position to help uncover violations. By reporting to the Administration any article he suspects, the physician may open the door to a significant violative activity. Through such cooperation, seriously misbranded and adulterated devices may be promptly and effectively removed from the market thereby effecting a life-saving measure.

The dangerous properties of a device may be learned only after unsuspected untoward effects begin to appear following its use. The inherent danger may be so serious as to warrant notification of the medical profession, as well as the initiation of a series of legal actions to remove the dangerous article from commerce.

Careful attention must be given to the proper evaluation of devices as new uses are recommended for units already on the market, as well as new devices being investigated for the first time.

Although the Act does not require a formal application to establish the safety of new devices such as is required for new drugs, the responsibility of the manufacturer or distributor is equally significant. Currently the clinical application of ultrasound in medicine is being investigated. Only through critical study by well-trained scientific workers is it possible to establish the mode of action, safety, and clinical usefulness of this type of device. In order to keep abreast of the medical developments in the field of devices, the Division of Medicine has worked closely with the American Congress of Physical Medicine and Rehabilitation.

For about the past 10 years the Congress has designated a special committee to cooperate with the Food and Drug Administration. The FDA has benefited greatly by this relationship and looks forward to continued and even closer cooperation.

Review of Legal Actions Since 1939

A review of the legal actions initiated since the provisions of the Act became fully effective gives an impressive picture. In the 17 years since 1939, over 500 cases (exclusive of those involving prophylactics) have been recorded. The majority of actions have been seizures, with about 40 criminal prosecutions and 10 injunction suits.

Some of the developments during this period may be noted. During 1939, a large number of seizures involved lead nipple shields as well as a variety of nasal douching devices held to be dangerous to health. The second year of enforcement dealt chiefly with actions against false and misleading therapeutic claims. During the war years there were relatively few legal actions. This reflects the lack of availability of metals and other critical war materials to manufacture nonessential devices. When metals and other materials again became available after the war, including many war-surplus electric parts, many devices reappeared on the market and a number of new ones appeared. Many were marketed in violation of the Act, as evidenced by the continuing pattern of actions beginning in 1946. The pattern of legal proceedings continued at a regular pace until 1951, when the administration added a physicist to the staff. This afforded a ready opportunity to evaluate the physical properties of a number of questionable devices on which action had been deferred. It also made it possible to undertake regulatory action against complex and involved devices. These required intensive and prolonged studies for evaluation. As recently as May, 1956 one of these involved suits was settled, based on criminal violation of an injunction.

A wide variety of devices has been the basis of court actions. These have involved infractions of all the legal requirements set forth in the Act. They deal with mechanical quackery of all types. At the annual meeting of the Congress held in Washington in 1954, the FDA presented some of the flagrant violations in an exhibition.

Aging Program

With the growing concern relative to our aging population, it is of special interest to note that opposed to the constructive work of scientists to help the aging are the destructive attempts of unethical promoters to exploit this group with quack remedies and devices purporting to bring better health and greater longevity. Arthritis quackery, for example, runs the gamut from copper wrist and ankle bands, which arise from age-old superstitions, to uranium tunnels and blankets bearing the guise of popular modern science. Quackery claims emphasize the symptoms of the chronic disease that afflict older people. The FDA is actively working to remove such unwarranted articles from the market.

Medical Devices That Need Further Study

In addition to the devices already discussed that have been subject to regulatory action in the past, there are currently certain classes of devices of considerable importance for which safety still remains undetermined. These include surgical implants, particularly those of plastic and metal, and radioactive applicators. Although neither class of articles has been involved in litigation that would establish them by legal definition as devices, establishment of their safety is essential if they are to be used in the practice of medicine.

In view of the primary responsibility of the FDA to assess safety of therapeutic articles, protection would be extended if measures similar to the "new drug" provisions of the Act were adopted for devices. Thus, formal application would be required before general marketing could be undertaken. Through this procedure, inherently dangerous devices would be denied distribution.

Citizens Advisory Committee

In 1955, the Secretary of the Department of Health, Education, and Welfare appointed a special committee of distinguished citizens to study the programs of the Administration and to make recommendations concerning the amount and kind of enforcement of the Act and

related statutes that would best serve the interests of the country. A lengthy report dealing with all of the regulated commodities was published in June, 1955.

The committee pointed out that the manpower available for assignment to drug and device programs appears to be well below the minimum required for the workload. It also noted that the current drug and device enforcement programs appear to represent minimum, or less than minimum, coverage of the field. It recommended that the device program be planned to include more extensive work on therapeutic devices for

which false claims are made in regard to diagnostic and curative properties. To date these considerations have not been implemented, although it is expected that this year may provide some furtherance of these suggestions.

Through cooperation of the physician, manufacturer, pharmacist, and Government it is possible to achieve the requirements of the Act. With the full cooperation of the members of the specialty of physical medicine and rehabilitation, further advances can be assured in our mutual interest to protect the public health and welfare by maintaining proper control of devices.

Announcement of Fellowships for Counselor Training in the Work with the Physically Handicapped

This year twenty fellowships in the amount of \$300 each will be awarded through the cooperation of the National Society for Crippled Children and Adults and Alpha Gamma Delta Fraternity for a four-week workshop for counselors of the physically handicapped which will be held at the Institute of Physical Medicine and Rehabilitation in New York City from June 17 to July 12, 1957.

Awards are made on a competitive basis to qualified professional persons who need and can utilize the training in counseling the physically handicapped. Consideration is given to academic and work background, references, reasons for taking training and utilization of training in the specific geographic location of the candidate.

The deadline for receipt of applications is March 15, 1957.



**National Society for Crippled Children and Adults
11 So. La Salle, Chicago 3**

Rehabilitation Program in Pennsylvania: The Pennsylvania Rehabilitation Center

Honorable John R. Torquato
Harrisburg, Pa.

The inclusion of vocational rehabilitation, modern style, on the program of the 1956 American Congress of Physical Medicine and Rehabilitation is an indication of the bearing that disability—especially neglected disability—has come to have on the over-all health and welfare of our people, not only in Pennsylvania but throughout the nation.

Vocational rehabilitation is the ideal culmination of medical care. It is not only a philosophy of services that constitutes a course of training and medical care through which the patient can be returned to his home free of his illness or disability, but also that he can participate to the limit of his potential in the social and economic life of the community.

Vocational rehabilitation services are being brought to thousands of our citizens annually. Last year the state vocational rehabilitation agencies, working with the Federal Office of Vocational Rehabilitation, restored 58,000 Americans to productive employment, gave them new life, new hope, new faith and an opportunity to contribute to the economic stability of our nation and the State of Pennsylvania. Our Bureau of Rehabilitation prepared and placed in gainful jobs 3,865 disabled. This is an all-time record for a 12-month period and indicates the growing need for helping the handicapped, and also the expanding steps being taken in Pennsylvania to meet this problem.

Yet, the rehabilitation of these thousands of persons—heart-warming though it was—fell far short of the goal that can and must be achieved. The problem of disability remains a momentous one.

Today, at least two million disabled Americans could be helped by vocational rehabilitation. A proportionate share of these, some 300,000, reside in the State of Pennsylvania. Ninety per cent of these are the victims of disease and congenital

conditions, and 10 per cent of employment, home, highway and other accidents. This is only part of the picture. Each year in the Commonwealth of Pennsylvania alone some 60,000 persons are injured seriously through industrial or public accidents and diseases. Of this number some 12,000 will be unable to return to their jobs or to enter their chosen vocations.

You might wonder what physicians, particularly those in physical medicine and rehabilitation, can do to help reduce these great losses in manpower and humanity, and to help cope with the awesome problem of disability. By using the specialized services of physicians it can be possible for many more patients to get the vocational rehabilitation services they need. Physicians can help do this by working closely with the state vocational rehabilitation agencies, by helping to place a trained handicapped person in a job, and by immediate referral of patients who need vocational rehabilitation to the bureau of rehabilitation in their state.

One might ask "Does vocational rehabilitation pay? We have been told about the cost of disability. What are the economic advantages of vocational rehabilitation?"

The profit side of the vocational rehabilitation ledger is well worth scanning. The citizens restored to productive employment through the state-federal vocational rehabilitation program during 1955 alone increased their earnings from \$16 million prior to rehabilitation to \$104 million thereafter. Broken down more simply for the State of Pennsylvania, the average wage of the disabled was increased from approximately \$10 to \$46 a week. The most significant part of

Read at the 34th Annual Session of the American Congress of Physical Medicine and Rehabilitation, Atlantic City, N. J., September 13, 1956.

Secretary, Pennsylvania Department of Labor and Industry.

this is that many of those who were earning a wage prior to rehabilitation were in danger of losing their jobs because of their disability, or they were earning just a small weekly wage and needed additional support in the form of public aid, compensation, or support from their families.

These rehabilitants will repay an estimated \$8.4 million in federal income taxes in their first year of employment and within 4 years are likely to pay income taxes in an amount greater than that invested in their rehabilitation by the government. The rehabilitation of these people eliminated an estimated \$8 million expenditure in taxpayers' funds that had gone into public assistance.

This shows most vividly that rehabilitation, a one-time expenditure and not a repetitious expenditure such as other forms of public aid, provides a savings to taxpayers along with offering humanitarian services to less fortunate citizens.

Rapid strides in rehabilitation have been made in Pennsylvania and elaborate plans are under way to continue these strides into the future. As an indication, the following example of advancements made in a period of some 10 years is cited.

Some 10 years ago, the father of three small children was injured seriously in an automobile accident while riding home from work. He became a paraplegic. After his savings and insurance funds were exhausted it was necessary for his family to depend on public and private assistance for support. His case was referred to the Pennsylvania Bureau of Rehabilitation, but unfortunately he could not be accepted for service. With laws restricting funds and limiting the area in which the bureau could operate, there simply was no service that could be provided for so severe a case.

But times have changed. Several weeks ago another man was referred to the bureau. The circumstances were the same—a crippling accident, permanent disability, personal funds exhausted. After his case was classed as feasible for rehabilitation, a program was started immediately despite the severe involvement. All the services necessary to return him to gainful em-

ployment were available and were prescribed—medical and vocational diagnosis, guidance and counseling, physical restoration, training, job placement and the all-important follow-up.

During the intervening years, an untold number of persons had applied for help but received a discouraging answer from the bureau. All too few citizens were provided with services of any type, because the federal and state rehabilitation program was limited in scope and personnel. In 1940, for example, as few as 730 handicapped Pennsylvanians were rehabilitated, the largest number in a single year up to that time. Virtually all of these were the less severely involved individuals who required only the minimum of services—in most cases training and the providing of a prosthetic appliance.

That was before public law 113 was enacted by the 1943 Congress. Since then many more patients have been given services by the bureau. In fact, a record number of 3,865 disabled Pennsylvania citizens were prepared for and placed in gainful employment during the calendar year of 1955.

Another all-time high of 15,125 disabled individuals were referred to the bureau during the year and services have been started, or are in the process of being started, for virtually all of them.

Plans are under way now in Pennsylvania to at least double the staff in the Bureau of Rehabilitation so that services can be provided to all of these disabled individuals as quickly as possible. Under construction is a modern rehabilitation center that will provide more and greater services to the severely disabled as well as the less severely involved.

When this 350 bed center is placed in operation next year it will be the greatest single forward step the commonwealth will have taken to care for its handicapped citizens in some 36 years.

The rehabilitation center will be designed to prepare the severely disabled for the most effective life of which they are capable. This will be accomplished through a well-integrated program that will enable the handicapped to receive simultaneously a treatment-training procedure including physical restoration,

vocational training, and personal counseling.

Some 30 different training courses will be offered at the center ranging from all types of arts and crafts to business courses, cabinet making, drafting, electrical appliances repair work, shoe and watch repairing, sewing, and upholstering. Vocational training will range from unit courses to skilled instruction as required in 95 per cent of the severely disabled cases. It will provide an opportunity for physical acclimation and psychological adaptation to working conditions imposed by a job on individuals who have not worked before and to those who have not been employed for an extended length of time.

The center especially will be tied in closely with the specialty of physical medicine and rehabilitation. The support and cooperation of this specialty will be needed to make this gigantic project the success it must be to serve the many thousands of handicapped citizens.

We are in the process now of planning a staff that will include a medical director and two staff physicians, all of whom must have a background in physical medicine. We will have an administrator; about 16 therapists, including physical, occupational and speech; some 30 vocational instructors; approximately 10 rehabilitation counselors; nurses, and of course the other necessary institutional and clerical help.

We in Pennsylvania are most anxious for the completion of the center so that more of the disabled can be served, particularly the more severely involved. In addition, the growth of the program virtually has made the construction of this center mandatory.

To describe briefly what I mean about the demands on the program in Pennsylvania and what is being done to meet these demands the following figures are cited:

During the past year an all time high of 12,950 disabled citizens were referred to the Bureau of Rehabilitation for services so that they could be prepared for gainful employment. A record number of 3,865 were totally rehabilitated and placed in gainful employment. Another all-time high of 24,753 were on the rolls

of the bureau. Of this number 13,413 were receiving services; 5,656 clients were being reviewed to determine eligibility for rehabilitation. The remaining 5,684 cases were closed because the individuals either were ineligible for or not interested in rehabilitative services, they required care other than rehabilitation, or they were referred to another agency.

It might be interesting to point out that physicians are becoming more interested and are cooperating more closely than ever before in the rehabilitation program in Pennsylvania. Referrals from physicians increased sharply during the past 5 years, in fact there was a gain of 152 per cent, or from 377 to 950. During that 5-year period from fiscal 1950 to 1951 through fiscal 1955 to 1956 the over-all increase in referral of cases to the bureau from all agencies and sources was 77 per cent.

Naturally, the staff had to be expanded considerably, and is still being expanded, to meet these overwhelming demands.

Some 50 new counselors have been added in the past year and a half. Definite plans are under way to continue expanding at this rate for the next 2 or 3 years at least. The staff of medical consultants was expanded, one or more of whom are assigned to the state and each of the 10 district offices.

Two years ago we had a chief medical consultant in the state office and one each in the district offices, which then numbered only nine. Today we have 26 medical consultants, most of whom average about 17 hours a week with the bureau. All of these consultants have private practices and devote what spare hours they are able to the bureau's program.

We hope that we can look forward to the continued cooperation from physicians, not only in Pennsylvania but in all other states, because they hold an important key to the success of this expanding program. A goal of 10,000 rehabilitations a year by 1960 has been set, and by that is meant the providing of services, vocational training, and ultimate placement in a gainful job. It can be seen from this figure that the assistance of physicians will be needed. I am

sure that it will be forthcoming because many already have demonstrated their willingness and intense desire to help the physically handicapped, not only in cooperation with the governmental rehabilitation program but also through other sources.

Here I would like to cite for you an Arabian proverb, the philosophy we constantly keep in mind in our efforts to serve the disabled. It goes something like this: "I had no shoes and complained until I saw a man who had no feet."

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— MEMBERSHIP NEWS —

Archives of Physical Medicine and Rehabilitation

Who?

What?

Where?

When?

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A. B. C. KNUDSON, M.D.

Dr. A. B. C. Knudson, Director of the Physical Medicine and Rehabilitation Service of the Veterans Administration in the Central Office at Washington, D. C., is the first VA physiatrist to head the American Congress of Physical Medicine and Rehabilitation.

Dr. Knudson assumed the duties of president at the recent meeting of the Congress in Atlantic City. He was president-elect during the preceding year.

He holds teaching appointments in physical medicine and rehabilitation at the George Washington University School of Medicine and the Georgetown University School of Medicine in Washington, D. C. He also holds offices in a large number of medical organizations.

A lieutenant colonel in the Medical Corps of the U. S. Army Reserve, Dr. Knudson has served since 1950 as director of the medical branch of the District of Columbia Army Reserve School. He has been a member of the Association of Military Surgeons of the United States since 1944.

His previous assignments with VA were at the VA hospitals in Minneapolis, Minn.; St. Cloud, Minn.; Battle Creek, Mich., and Dwight, Ill.

Dr. Knudson received his M.D. degree from the University of Minnesota Medical School in 1939 and interned at St. Mary's Hospital in Minneapolis.

He was certified as a Diplomate of the American Board of Physical Medicine and Rehabilitation in 1947, the first year that this board held examinations for certification. Since 1949, he has been an official member of the board itself.

He is a Fellow of the American College of Physicians; a member of the American Medical Association, the Industrial Medical Association, and of the American Academy of Physical Medicine and Rehabilitation. He is a member of the District of Columbia Medical Society and several other medical associations.



MURRAY B. FERDERBER, M.D.

Doctor Murray B. Ferderber of Pittsburgh, Pennsylvania will serve as president of the American Academy of Physical Medicine and Rehabilitation for the year 1957.

Doctor Ferderber was born in 1902 at Duquesne, Pennsylvania. He took his formal training at Rush Medical College, Chicago, and was graduated in 1933. As a Diplomate of the American Board of Physical Medicine and Rehabilitation, he has served his field extensively as both medical director of many hospital department staffs and advisor of various lay groups. His contributions to medical publications have been many. Doctor Ferderber is an active member of the American Congress of Physical Medicine and Rehabilitation and is at present Assistant Professor of Medicine at the University of Pittsburgh.



OSCAR O. SELKE, JR., M.D.

The Editorial Board of the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION is pleased to welcome its newest member, Doctor Oscar O. Selke, Jr., of Houston, who has accepted this duty in the place of Doctor George M. Piersol of Philadelphia for a period of seven years.

Doctor Selke, a Diplomate of the American Board of Physical Medicine and Rehabilitation since 1949, is now Chief of Physical Medicine and Rehabilitation at Hermann Hospital in Houston. Born in 1917, he was graduated from the University of Texas School of Medicine at Galveston in 1941. Since that time he has been affiliated with the Veterans Administration, Harris County Cerebral Palsy Treatment Center, the Medical Corps of the Air Force and Baylor University. An active member of the Congress, Doctor Selke is also a member of the American Medical Association, the Southern Medical Association, and the American Academy of Physical Medicine and Rehabilitation.

physical medicine abstracts

Influence of Furadantin Treatment on Stone Growth. Experimental Urolithiasis. XI. W. H. Chapman; L. Seibutus, and C. W. Vermeulen. *J. Urol.* 76:42 (July) 1956.

Persistent urinary tract infections were created in rats by inserting into the bladder a standard foreign body contaminated with a known organism. The organisms used were *Proteus mirabilis*, *E. coli*, and *E. intermedium*. Furadantin was used to treat these infections. "Using doses of furadantin approximately ten times the human dose, cures resulted in sixty-five per cent of the animals with *Proteus mirabilis* or *E. intermedium* and in eighty-four per cent of the infections with *E. coli* despite the presence of the foreign body." The value of prolonged treatment was demonstrated.

Approximately equivalent human doses of furadantin and terramycin were tried against *E. coli* infections. Furadantin effectiveness was demonstrated.

As has been previously reported, *Proteus mirabilis* in these experiments augmented the growth of calculus on the foreign bodies while both *E. coli* and *E. intermedium* infections served to inhibit such stone formation.

A Self-Managed Bladder Training Device for Tetraplegics. A. E. Comarr. *J. Urol.* 76:200 (Aug.) 1956.

A device which can be managed by the quadriplegic to release a clamped catheter is described and drawn to scale. If the patient has elbow flexion he can manage the handle of the device. A system of strings can be attached so that the patient needs only to turn his head to open his catheter. This is a good method to make the patient more independent and to save man-hours for personnel involved in patient care.

Functional Bracing of the Arm. E. R. Schottstaedt, and George B. Robinson. *J. Bone & Joint Surg.* 38-A:477 (June) 1956.

Functional bracing of the upper extremity demands maximum mobility and minimum weight of apparatus. Bracing to aid with the basic light activities of the upper extremities is attempted. These are the most important activities of the upper extremities. No attempt has been made to supplement the heavy duty

activities performed by the arms. Braces should be planned to accomplish specific tasks. Functional arm bracing must be made to order for each patient; therefore a careful analysis of the patient's residual muscle function is always necessary. The functional movements of the upper extremity in the order of their importance are grasp or some component of it; elbow flexion and extension; internal and external rotation of the shoulder, and pronation and supination of the forearm. A patient can get along satisfactorily without wrist motion, shoulder abduction, shoulder elevation, or forward shrug, and with only slight shoulder flexion. The brace should be constructed so that the patient can put it on and take it off by himself. A description and drawings are given of the apparatus needed to supplement or replace function of the upper extremities. Motors described are rubber bands or motion of a normally functioning joint of some other part of the body.

Functional Bracing of the Arm. E. R. Schottstaedt, and George B. Robinson. *J. Bone & Joint Surg.* 38-A:841 (July) 1956.

This paper is a follow up of a previously published article. Specific examples are given of cases with a description of the bracing used in each case. Eight cases with residual muscle weakness following poliomyelitis are described. One case with a brachial plexus injury and one case of quadriplegia following cervical cord injury are included. A description of the patient's muscle function is given in each case along with a description and pictures of the functional bracing which was used for the patient.

The Present Status of Anticoagulants. William T. Foley. *J. Chron. Dis.* 3:448 (Apr.) 1956.

In persons over the age of fifty years, thromboembolism is the leading cause of death and invalidism. In recent years all types of thromboembolism have been treated with anticoagulants. In subacute bacterial endocarditis it was thought that Dicumarol was contraindicated. Recently it has been used with penicillin with good results. In phlebitis the mortality from subsequent pulmonary emboli can be reduced from 18 per cent to less than 1 per cent by the use of anticoagulants. Recently it has been sug-

gested that anticoagulants be reserved for severe cases of myocardial infarction. Use of anticoagulants in cerebral vascular disease is still an experimental field. Long-term therapy has been quite successful in preventing emboli from fibrillating auricles. Heparin now can be injected subcutaneously in a highly concentrated form. Its anticoagulant activity will begin in one hour and last fourteen to twenty hours. Oral anticoagulants other than Dicumarol are Tromexan, Marcumar, and Phenylindanedione. Vitamin K, given orally, will reduce unduly elevated prothrombin times to a therapeutic level in a period of six hours. The antidote for heparin is protamine. Anticoagulant therapy should be administered cautiously.

The Use of Frontal Lobe Procaine Injections in the Treatment of Mental Disorder. J. M. Whitworth; L. M. Weinberger; M. B. Zimbler, and A. F. Paolino. Ohio M. J. 52:727 (July) 1956.

The authors first review briefly the principal advances in psychosurgery. At the present time it appears that the beneficial results and the complications of frontal lobe surgery are related to the amount of brain tissue destroyed rather than to any particular tracts of fibers sectioned and that for practical purposes, the frontal lobes may be considered as equipotential masses of tissue. Deterioration of the personality and intellect increases in direct proportion to the amount of tissue removed surgically. Since brain tract anatomy is irrelevant, any method of graded destruction is suitable. Various chemical means have been tried to accomplish this since it is difficult to do by surgical technics because of vascular injury. The authors used, in a series of 36 patients, 20 to 30 cc. of 0.5 per cent procaine solution injected into each frontal lobe. This produces small areas of cystic necrosis. It has not been determined whether this results from the distending effects of injection into soft brain tissue or whether some other toxic effect is the cause. The authors favor the mechanical explanation since flecks of brain tissue appear in the syringe when the solution is barbotaged repeatedly into the brain. Advantages of this technic are avoidance of the hemorrhage and other hazards that result from surgical procedures, small increments of destruction can be produced, and various parts of the frontal lobe can be injected. Although psychoses are not cured by producing organic injury, worthwhile social gains and relief for the patient are obtained. About two-thirds of the patients treated by the authors in this series have been able to work effectively at home or at a job after receiving the treatment described, although all of them had failed to respond to other forms of treatment. The detectable organic destruction was slight and can be identified only by mild impairment of memory; gross deterioration of the intellect or personality did not occur.

Course of Exacerbations of Multiple Sclerosis in Hospitalized Patients. J. F. Kurtzke. A. M. A. Arch. Neurol. & Psychiat. 76:175 (Aug.) 1956.

The authors report on the clinical course of 220 patients with a diagnosis of multiple sclerosis hospitalized at the Bronx VA Hospital. The average duration of hospitalization was 104 days and therapy consisted of bed rest at will and a general diet. The patients were divided into two groups depending on the time of onset of their symptoms prior to the hospitalization with the dividing line being placed at two years.

No patient improved whose present episode or exacerbation had persisted for more than two years before admission.

Improvement was noted in 33 per cent of the patients whose onset of symptoms was less than two years prior to the present admission.

The outcome of the present episode could not be correlated with the total duration of the illness, the age of onset, the type of involvement, the severity at the time of admission, the prior nature of the illness, or the laboratory findings on admission.

Improvement or remission was inversely related to the duration of the episode prior to admission.

Pathogenesis of Experimental Poliomyelitis: I. The Virus Content of the Cerebrospinal Fluid. G. Kersting; H. Lennartz, and H. Pette. Deutsche Ztschr. Nervenheilk. (In German) 175:72 (No. 1) 1956.

Whether the virus of poliomyelitis is spread through the blood stream or along the nerves is still in doubt. To investigate this question, the authors performed experiments on 18 African monkeys. Six monkeys were given intraneural injections of a suspension of the Brunhilde strain of poliomyelitis virus, six received intramuscular injections of this suspension, and six were given 5 ml. of a concentrated suspension orally. Poliomyelitis did not develop in the monkeys given the oral preparation and the virus could not be detected in their blood or cerebrospinal fluid. Injection into the sciatic nerve of three monkeys resulted in typical symptoms of paralytic poliomyelitis in 5 to 10 days, which proved fatal in 2 or 3 more days. About 4 days prior to the appearance of neurological symptoms, viremia was detectable. This usually disappeared by the time paralytic symptoms appeared, but the virus was detected in the cerebrospinal fluid 2 days after it appeared in the blood. At the onset of paralysis the virus was generally still detectable in the cerebrospinal fluid. Similar results were achieved with three monkeys that received injections into the ulnar nerve, except that the virus was never found in the cerebrospinal fluid. Poliomyelitis developed in two of three monkeys given the virus intramuscu-

larly in the left upper arm. Viremia was present in all three monkeys. At the onset of paralytic symptoms in the monkeys that developed poliomyelitis the virus was also present in the cerebrospinal fluid. The virus was also found in the blood and cerebrospinal fluid in one of three monkeys that received injections in the right thigh. This monkey had symptoms of poliomyelitis; the other two did not. Since, in these experiments, the central nervous system did not become involved unless viremia had been present, and because of the chronologic relationship between the appearance of the virus in the blood and cerebrospinal fluid and the onset of paralytic symptoms, it would appear that the virus reaches the central nervous system via the blood stream. The authors are of the opinion that the virus is transmitted simultaneously through the blood stream to the cerebrospinal fluid, the tissues of the brain, and the spinal medulla. During the symptom-free period, damage to the motor nerve cells seems to reach a level at which the first signs of paralysis appear.

Action of Local Hydrocortisone on Special Cord Wounds. A. Ortiz-Galvan, A. M. A. Arch. Neurol. & Psychiat. 76:34 (July) 1956.

The anti-inflammatory properties of hydrocortisone have been explained as being due to a direct action on the fibroblast cell, interference with the elaboration of ground substance, and alteration of the permeability of the vessels.

Fifty-four young cats were subjected to partial section of the spinal cord. One-third were treated by the local application of hydrocortisone acetate powder, one-third with a saline suspension of hydrocortisone acetate, and one-third were used as controls. Animals were sacrificed at 1½ and 6 hours; 2, 4, 12, 18, 30, 45, and 83 days and 6½ months. Sections of the wound were examined microscopically.

It was noted that hydrocortisone actually delayed healing when applied locally in high doses. The phagocytic activity of the granular cells was depressed and delayed.

Degeneration was also delayed especially in the medium and fine fibers. This action was suggested as being due to a protective effect of the hormone.

No significant alteration in the rate or degree of regeneration was noted.

The Effect of Anticoagulant Therapy on Bone Repair. F. E. Stinchfield; B. Sankaran, and R. Samilson. J. Bone & Joint Surg. 38-A:270 (Apr.) 1956.

Sixteen rabbits and ten mongrel dogs were subjected to anticoagulant therapy before and after a semicircular disc of bone was removed from the ilium. All animals, as well as an equal number of controls, were sacrificed four weeks after the surgery.

Heparin and Dicumarol given one week pre-operatively caused minimal delay in union as compared with the control. Dicumarol given immediately post-operatively showed an even greater delay in union and this delay was more marked than was noted when heparin was used immediately post-operatively.

Administration of the anticoagulants either separately or in combination one week post-operatively had only a minimal effect on healing.

The delays are ascribed to two possible explanations: (a) Mechanical: lack of scaffolding in the form of the fibrin clot; and (b) Cellular: due to the toxic effect of anticoagulants, there may be a definite diminution in the number of cells at the graft site or there may be an alteration in the normal metabolic process in the bone matrix.

Two New Ganglion-Blocking Agents in Treatment of Hypertension. S. Locket. Brit. M. J. 2:116 (July 21) 1956.

Results are reported on clinical tests with two new ganglionic blocking agents used in the treatment of hypertension. The agents are designated as 356c54, N¹, N², N³-trimethyl-N¹-(6-cyano-6, 6-diphenylhexyl) ethylene-1-ammonium-2-morpholinium dichloride, and 139c55, the 5-cyano-5, 5-diphenyl-pentyl homologue (Presidal). An important property of this group of compounds is the apparent dissociation between their hypotensive activity and their ability to produce ocular changes and gastrointestinal disturbances. The solution used contained 20 mg. of the dichloride per 1 ml. The minimal effective single intravenous dose of 356c54 to produce a fall in diastolic blood pressure below 100 mm. Hg. was 2 mg.; the maximum was 12 mg. The minimum effective single therapeutic dose given subcutaneously was 10 mg.; the maximum was 40 mg. With 139c55, similarly effective doses were about half of these. The first detectable pharmacological response occurred in 5 to 25 minutes. Blurring of vision occurred after about 6 minutes, often accompanied by bradycardia that began 10 to 20 minutes before the onset of hypotensive effects. Blood pressure fell within another 10 minutes; the maximum fall occurred 45 to 60 minutes later. The hypotensive effect disappeared gradually some time before the bradycardia subsided. The pattern of activity after subcutaneous injection was similar to that occurring after intravenous injection, but the appearance of signs of response was somewhat delayed and the duration of hypotensive action was much longer, especially with 139c55. When the drugs were given orally, there was often considerable delay before blood pressure began to fall, and the degree of hypotension was difficult to predict. Gastric emptying, small intestine propulsion and large intestine propulsion were not affected in the same degree by various ganglionic blocking agents. The drugs 356c54 and 139c55

did not appreciably affect small intestine propulsion; 139c55 produced much less delay in gastric emptying than did 356c54. Gastric absorption of the drug did not seem to occur, which explained the delay in onset of hypotension after oral administration. Angina of effort and severe paroxysmal nocturnal dyspnea ceased to occur during effective hypotensive treatment. Several patients showed a return to a more normal electrocardiogram. Brief case histories of 15 patients given these two new ganglionic blocking agents also are reported.

Drug Therapy of Hypertension: II. Experience with Reserpine, Apresoline, Ansolsen, Ecolid, and Mecamylamine (Inversine). M. Moser; A. I. Macaulay; R. Granzen, and K. W. Trout. New York J. Med. 56:2487 (Aug. 15) 1956.

Sixty patients with severe, complicated hypertension were treated with reserpine and hydralazine (Apresoline) alone or in combination with pentolinium (Ansolsen), mecamylamine (Inversine), or other similar drugs. The patients were initially hospitalized, routine studies of cardiac and renal function were carried out, and they were screened for pheochromocytoma, coarctation of the aorta, and other forms of secondary hypertension. Funduscopic examinations and ocular tension studies were done periodically; electrocardiograms and chest x-rays were taken every 3 to 6 months. Reserpine and alseroxylon were effective in about 30 per cent of cases of mild hypertension, but were of little value in severe hypertension except for use as adjuncts to therapy with ganglionic blocking agents. Their side-effects are usually mild, and dosage adjustments not critical, but Rauwolfia drugs may cause severe depression, activation of peptic ulcer, and weakening. Hydralazine is particularly useful in the treatment of patients

with severe renal disease because it can produce at least a temporary increase in renal plasma flow despite a fall in blood pressure. A late toxic reaction consisting of joint pains, fever, and abnormal liver function tests, and, in the more severe form, the presence of "lupus cells" in the bone marrow or peripheral blood occurred in 6 to 8 per cent of the patients on long-term therapy. Hydralazine given orally with rauwolfia was effective in about 30 per cent of patients with moderately severe to severe hypertension. The average daily dose was 400 to 500 mg. Pentolinium provides a satisfactory response in about 30 per cent of patients, but it produces dry mouth, blurring of vision, and constipation, which could result in serious side effects because of the prolonged absorption of the drug. Although chlorisondamine appears to be of value in severe hypertension, persistent blurring of vision occurs with its use. Mecamylamine appears to be a useful addition to the ganglionic blocking agents used in hypertension. With this drug a predictable result is obtainable upon oral administration.

Based on 4 years experience with drug therapy of hypertension the authors make the following recommendations: (1) Reassurance, sedation, and "de-emphasis" of blood pressure is usually sufficient therapy for patients with uncomplicated hypertension. (2) In patients with complicated disease, the risk of therapy should be weighed against the prognosis for the patient if untreated. (3) In less severe cases, rauwolfia alone or in combination with hydralazine should be utilized; in more severe cases, mecamylamine in combination with these agents is recommended. (4) Treatment should be aimed at symptomatic relief for patients with renal failure; however, drugs should be discontinued or reduced if azotemia increases. (5) If drug therapy is not effective in severely ill patients without renal failure, surgical sympathectomy should be considered.

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book reviews

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Academy of Physical Medicine and Rehabilitation.

ANKYLOSING SPONDYLITIS. Clinical Considerations. Roentgenology, Pathologic, Anatomy, Treatment. By J. Forestier, M.D.; F. Jacqueline, M.D., and J. Rotes-Querol, M.D. Cloth. Price, \$10.75. Pp. 374, with illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1956.

This is a carefully planned book describing clearly and meticulously the picture of ankylosing spondylitis, as these clinicians have seen it. They describe and define the stage of onset, the stage of obvious diagnosis, and the advanced stage. As a basis for their work, they have studied 200 patients over a relatively long period of time. The "Contents" is an excellent outline of the contents of the book so that special material is easily located for special reference. They emphasize the need for a very careful history and for a careful clinical examination of every joint. They measure pain as carefully as possible, partially by the necessary medications. The patient's height, deviation from the vertical, etc., are all charted. The symptom of pain is localized as carefully as possible; its radiation studied along with the time of day in which it is most apt to occur and the position of the patient. The authors are particularly interested in that pain caused by the sacroiliac joints, when pathology appears here, as this can help to differentiate from lumbosacral pathology, as well as assisting in localizing the pathology to the sacroiliac joints. The technic for radiological studies and the interpretation of these are discussed. Sacroiliac involvement is a "constant sign." All of the laboratory tests are described.

Though all phases of the disease are described, that pertaining to "Modes of Onset" is of particular significance. The authors are very interested in the study of the first symptoms. "The phase of onset is that during which there is not yet any definite and permanent limitation in the mobility of the spine." They regard as the onset of the disease the appearance of the first articular symptoms, wherever they may be situated, and whether spinal or peripheral. "The diversity of the initial symptoms gives to the onset of the disease a disconcerting polymorphism. Thus, a clinical symptom, such as a monoradicular sciatica, a lumbago, an iritis, hydroarthrosis of the knee or an arthritis of the hip, may, by itself and for a rather long time, constitute the entire clinical picture at the beginning of the disease. Failure to recognize this period, which

antedates clinical involvement of the spine, explains why these patients are allowed to drag along for six or seven years, or even longer, without any definite diagnosis and within appropriate treatment."

Under "Modes of Evolution" three types of evolution are specified. Ascending extension (90 per cent), diffuse involvement (7 per cent), descending extension (3 per cent). They describe the ankylosing forms with painless spinal evolution and those without pain. Here they make an interesting differentiation in the radiological picture. Where the ankylosis has occurred without pain, the vertebral bodies preserve their recto-linear borders. The discs are abnormally thin and appear to be ossified. The intraspinal and supraspinal ligaments become ossified, and ankylosis occurs in the interapophyseal articulations and probably ossification occurs in the ligamentae flava. In that form in which pain occurs, we see that which is much more familiar. The syndesmophytes jut out and produce the well-known appearance of a bamboo stem. The pathogenic anatomy, both gross and microscopic, is described in detail and excellent space is given to treatment from the standpoint of medication, radiology, orthopedic hygiene, and physical therapeutic care. This book is very readable, very precise, and should be read by anyone even remotely interested in the subject of arthritis.

THE NEUROSURGICAL ALLEVIATION OF PARKINSONISM. By Irving S. Cooper, M.D. Cloth. Price, \$8.50. Pp. 104, with illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1956.

Dr. Cooper is a neurosurgeon whose efforts to relieve the effects of Parkinsonism by surgical procedures have caused his name to become closely associated with the disease. He has prepared a manual to summarize the present status of surgical therapy for Parkinsonism.

Proper selection of patients for operation along with surgical technics is emphasized.

The problem of Parkinsonism is very well evaluated in the opening chapter. Surgical occlusion of the anterior choroidal artery and chemopallidectomy are very thoroughly covered and the theory is supported in each instance by illuminating case reports.

This book will be of interest to every physician. It is necessary to understand the facts that Dr. Cooper presents before anyone can be on instrument in selecting patients for surgery. This understanding will also make our associates in Physical Medicine and Rehabilitation understand the great hope that neurosurgery offers the patient with brain damage in the years to come.

The type is most easily read. There are splendid illustrations, diagrams, and plates which are most helpful.

PHYSICAL MEASURES IN THE TREATMENT OF POLIOMYELITIS. By Robert J. S. Reynolds, S.R.N., M.C.S.P. Cloth. Price, \$2.50. Pp. 140. The Macmillan Company, 60 Fifth Ave., New York 11, 1956.

Those who are aware of advances in the care of poliomyelitis which have taken place in the last five years will find this volume lacking in many of the aids which are now accepted as routine. While there is good presentation of the conventional hot pack, muscle re-education and ambulation procedures, no mention is made of such devices as tilting table, rocking bed or chest respirator.

A superficial survey of the literature concerning epidemiology, pathology, orthopedic appliances and surgery is given, in addition to the usual muscle action outline. Emphasis is placed on the Kenny concept, though description is not complete.

This volume adds nothing to the literature on poliomyelitis, although it may be found useful to the casual student of the disease.

DIRECTORY FOR EXCEPTIONAL CHILDREN: Schools, Services, Other Facilities. Second edition. Edited by E. Nelson Hayes. Cloth. Price, \$4.00. Pp. 247. Porter Sargent Publisher, 11 Beacon St., Boston 8, 1956.

This volume is a necessity for any who deal with exceptional children. Schools are listed according to support: public, private or state; types of cases taken; and training centers for speech, visual and psychiatrically handicapped. In each section, schools are grouped according to regions, states and cities. Pertinent information is given such as age limits, tuition and staff.

A listing of state programs and personnel, and associations, foundations and societies is given. The volume is fully indexed.

DOCTOR AND PATIENT AND THE LAW. By Louis J. Regan, M.D. Third edition. Cloth. Price, \$12.50. Pp. 716. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., 1956.

This is an excellent reference on general problems of legal medicine. It can also well

serve as a textbook on legal medicine for use by students of medicine. As in previous editions, the major part of this book deals with problems of malpractice, the law thereon and illustrative cases. This third edition utilizes this material from the second edition plus an additional 147 pages of more extensive discussion and the new material. A new section has been added on grievance committees at the county society level. There is also a helpful discussion of the problem of experimentation, concluding with the recommendations of the Judicial Council of the American Medical Association with regard to human experimentation. Other new topics covered are the law of public health, feticide, infanticide, and concealment of births or deaths. This book is highly recommended to both physician and lawyer.

TEXTBOOK OF MEDICAL PHYSIOLOGY. By Arthur C. Guyton, M.D. Cloth. Price, \$13.50. Pp. 1030, with 377 illustrations. W. B. Saunders Company, W. Washington Sq., Philadelphia, 1956.

Arthur Guyton, Professor of Physiology and Biophysics, University of Mississippi School of Medicine, and a man highly regarded in physiology circles, has written a single author textbook which has certain advantages over a multi-author compilation. The style of presentation is consistent throughout the book, and there is an easy flow of discussion from one topic to another. There are frequent references from one section of the book to other sections which save needless repetition yet lend thoroughness to the presentation. The text is remarkably easy reading, never requiring re-reading of phrases or sentences and maintaining the reader's interest with good journalistic style. Although the author states the book was meant to be a text for students and not a reference book, the book allows quick scanning of pages and finding of desired information through the use of paragraph headings which head approximately 50 per cent of the paragraphs. The material presented concerns human physiology, with minimum reference to animal physiology.

Illustrations, diagrams and charts are clear and require minimum time for understanding. There is an extensive and detailed table of contents and index, both which allow quick location of desired subjects. Each chapter has a bibliography of pertinent and recent publications for the reader to use for further investigation.

The inclusion of the physiological aspects of newer treatment theories and technics makes the book up to date. For example, there is a chapter on nuclear physics and its relationship to the human body.

The reviewer considers this an excellent textbook of physiology.

A SCIENTIFIC REPORT ON THE SEARCH FOR BRIDEY MURPHY. Edited by Milton V. Kline, Ph.D. Cloth. Price, \$3.50. Pp. 224. The Julian Press Inc., Publishers, 80 E. 11th St., New York 3, 1956.

This book deals with psychological problems involved in "The Search for Bridey Murphy" by Morey Bernstein, a widely publicized and serialized book dealing with hypnosis, reincarnation, and parapsychology. The "Scientific Report" presents a more accurate account of hypnosis for other scientists and the layman. The authors point out that the principal part of the "Bridey Murphy" book, the recollection under hypnosis of a previous life in Ireland by a Colorado housewife, is actually a fantasy of reincarnation. Such fantasies are frequently encountered in experimental and therapeutic hypnosis, but scientific workers in the field explain them as manifestations of multiple personality based on forgotten experiences and the subject's imagination. There can be no doubt that such a book is sorely needed to counteract the misconceptions presented in the "Bridey Murphy" story. Also, it is regrettable that the authors of the "Scientific Report" will no doubt be deprived of the wide audience presented to Mr. Bernstein by newspaper editors who sensed the circulation building power of the "sensational" story. However, it is equally regrettable that a book presented as a scientific report should indulge in some questionable practices in their zeal to discredit a sensationalist. One of these practices is circumvention. Mr. Bernstein had asked, "Why does not every doctor understand the fundamentals of hypnosis? Why is it not a 'must' for every psychiatrist? What is the reason that science does not show more interest?" The scientists avoid the first question by answering that all doctors cannot specialize in one branch of medicine. But Mr. Bernstein had recommended only that doctors *learn the principles*. Certainly they should not deny that a working knowledge of hypnotism would be especially desirable for the psychiatrist. As for the third question, Mr. Bernstein is not the first to decry the lack of scientific interest in this field; the authors themselves imply the same regret in their foreword. They are on sounder grounds when they point out that, historically, literature such as the "Bridey" book has hindered rather than augmented acceptance of and constructive interest in hypnotism. Another example of avoiding the issue occurs when they discuss Bernstein's use of hypnosis for direct removal of painful symptoms. The authors wisely state that such a practice, especially by a nonmedical man, is dangerous in that the symptoms are usually manifestations of a more serious underlying condition that would be masked if the more obvious signs were removed. But is it not possible to remove physically or psychologically painful symptoms that in themselves serve to perpetuate or aggravate the basic cause, such as spasms, stuttering, or dermatoses? Unfortu-

nately for the enlightenment of serious students of hypnosis, this seemingly legitimate question is not discussed. At some points in the "Scientific Report" the value of the authors' superior knowledge is impaired because they employ sarcasm. "'The Search for Bridey Murphy' is said to be out of this world—and in many ways it is." "It pays (financially) to practice mysticism." "How comfortable! How satisfying to a depressed goalless soul!" "Goliath is a mere punk." Irrelevant, too, are lengthy quotations from two unfavorable lay reports, presumably book reviews, by persons who did not find the book interesting. The "Scientific Report" criticizes Bernstein for using the term *narcosynthesis* when he should have used *narcoanalysis*, for calling the *Journal of Clinical and Experimental Hypnosis* the *Journal of Experimental Hypnosis*, for confusing the terms *hypnotic* and *narcotic*. They question Bernstein's technic because he didn't use the open-eye trance and because his subject talked back to him and even asked questions. Yet, in another part of their book where the nature of hypnosis is described it is stated, "Although the situation is usually clearly defined, and the hypnotist is in the controlling position, there are times when the patient does take over [and the hypnotist may find] that he is at the mercy of the omnipotent infant who is his hypnotic subject." They also psychoanalyze Bernstein from the material contained in his book, concluding that he is poorly motivated and that his interest in hypnosis and reincarnation is "an expression of his hidden rebellion against his father." Even if this is true, it is certainly of dubious value as influential material for the layman already suspicious of the Freudian school of thought; also, it is based on inadequate evidence. From a simple figure of speech used to point out that a hypnotist, like a dancer, must combine talent with practice the authors conclude: "He seems to equate dancing with hypnosis. It may be that, since dancing is in itself a cultural expression of sexual function, hypnosis is a sexual expression for the author of this book." As a final example of lack of scientific decorum in the "Scientific Report," the authors claim that since Harry Houdini stated that spirits are reputed to have the gift of knowing all languages, Bridey Murphy should have been able to have spoken Gaelic. This might have been construed as humor had the authors not shown a lack of this quality by describing as "emotionally impoverished" a hostess who gave a Bridey-inspired come-as-you-were party.

Although the difficulty of the authors' maintaining a strictly objective view of a book such as "Bridey Murphy" can be appreciated, their employment of sarcasm, circumvention, and pedantry in an otherwise informative book is distracting. The "Scientific Report" would have been much more interesting and convincing, too, if it had countered the "Bridey" story with several of their own examples of fantasies of reincarnation since

"the literature on hypnosis abounds in many much more interesting examples of this type." But they cite only one good case to bolster their argument, and this is found in the introduction. Despite the inadequacies mentioned in this review, the book should be read by all those who "learned" about hypnotism, reincarnation, and parapsychology from reading "The Search for Bridey Murphy" since the "Scientific Report" does present a more objective and better founded discussion of these subjects.

FIFTH ANNUAL REPORT ON STRESS. 1955-1956. Edited by *Hans Selye, M.D.*, and *Gunnar Heuser, M.D.* Cloth. Price, \$20.00. Pp. 815, with illustrations. MD Publications, Inc., 30 E. 60th St., New York 22, 1956.

This book is the fifth of the yearly reviews of current literature on the physiologic and pathologic effects of the adrenocortical hormones, which have appeared subsequent to Selye's *Stress*. The editors state, "These volumes are published with the hope that they will act as guides to the entire literature on stress and that they will help to correlate all pertinent facts, even those which may appear to be quite unrelated." The volumes offer "a classified guide system to approximately 30,000 references on stress, the adaptation syndrome, and the adaptive hormone."

The first part of this volume begins with an article on the general physiology and pathology of stress, written by Selye, which covers some 80 pages. In it Selye points out that "stress" is a physiologic response to a non-specific stressor. The general adaptation syndrome and the pathways of the physiologic mechanisms are reviewed.

In an analysis of the chronology of the syndrome, topical and systemic cross-resistance and crossed-sensitization are discussed. The article concludes with an analysis of the experimental and clinical diseases of adaptation. Under the latter are listed aldosteronism, hypertension, nephrosis, nephritis and nephrosclerosis, periarteritis nodosa, rheumatic fever, rheumatoid arthritis, disc syndrome, tendon contractures, liver disease, thyroid disease, glycogenosis (von Gierke's disease), tumors, and schizophrenia.

The next 100 pages are taken up by a series of nine special articles written by different authors. Of particular interest to psychiatrists are the articles on primary aldosteronism, the role of the adrenal cortex in the etiology of disease, some observations on psychiatric stress in infancy, and cortisone in relation to lymphoid tissue and immunity.

The second part of the book is a bibliographic compilation and cross-indexing of 5,698 references related to the special physiology and pathology of stress which were published in 1955. The tabulation is preceded by some remarks on the method of tabulation

and the method of using this indexing system as a source of references.

The third part of the book is an article entitled "Endotheliomyelosis — An Experimental Model of the 'Focal Syndrome'" by Selye and Bois. This interesting article reviews some past concepts of the importance of focal infections in clinical medicine. The authors report on an empirical method of establishing a chronic focal infection in rats, devised by them at the Institute of Medicine and Experimental Surgery of the University of Montreal. Rats of a pure strain, unilaterally nephrectomized and thereafter given exclusively 1 per cent solution of sodium chloride as a drinking fluid, have been given by injection under nonsterile conditions a solution of casein in Freund's adjuvant. This produces a rather constant morbidity in the rats.

The authors state that the syndrome is produced by some type of infectious organism contaminating the protein solution. However, they have not isolated the particular organism concerned, and it has not been possible as yet to demonstrate the presence of any streptococci in the most active preparations.

The focal syndrome in the rats is characterized primarily by endocarditis not unlike that seen in man in severe acute rheumatic fever. Changes in the kidney suggestive of early nephritis are seen which involve the convoluted tubules and the glomeruli. These changes are usually accompanied by polyuria. Changes in the adrenal cortex include foci of necrosis and ultimately the development of some myeloid tissue. In the spleen and in the liver there is a considerable development of myeloid hyperplasia. Ulceration of the gums around the upper incisors has been noted. In many animals fever up to 104 F. develops. The concentration of serum polysaccharides is increased. At the sites of injection of the protein substance, there was invariably a central focus of necrosis surrounded by a reactive inflammation.

The use of a multitude of abbreviations for various hormones and types of reactions makes the reading of the general review article by Selye difficult for one who is not working steadily in the field of steroid hormones. Although the book is intended primarily as a current reference manual for persons who are working with basic and clinical research connected with the adrenocortical hormones, it contains much stimulating food for the thinking of any physician. Some of it is rather confusing because of large gaps in our knowledge, which do not permit the knitting together of a multitude of empirical observations into a clear pattern. This is a book which should be available to all physicians in every medical reference library. The authors and publishers are to be commended for the preparation of such a volume.

BLAKISTON'S NEW GOULD MEDICAL DICTIONARY. Second edition. Edited by *Norman L. Hoerr, M.D., and Arthur Osol, Ph.D.* Leatherette. Price, \$11.50. Pp. 1463, with illustrations. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, 1956.

It is a pleasure to be introduced to such a fine publication as this second edition of an earlier work. In the modernization of this edition, 12,000 new terms have been included and obsolete terms have been omitted. To assist in making this publication comprehensive in scope, the aid of 88 qualified contributors was enlisted. The American Congress of Physical Medicine and Rehabilitation is represented among these individuals by Doctor Otto Glasser (special field of medical physics), and Doctor Robert Stecher (special field of rheumatic diseases).

The dictionary has many excellent features. It is highly recommended to those interested in medical writing and certainly should be in all medical libraries and available to all persons in medicine and related fields.

ELECTROCARDIOGRAPHY. Fundamentals and Clinical Application. *Louis Wolff, M.D.* Second edition. Cloth. Price, \$7.00. Pp. 342, with 199 illustrations. W. B. Saunders Co., W. Washington Sq., Philadelphia 5, 1956.

This book covers the subject of electrocardiography in the usual accepted manner. Part one deals with the basic principles of electrocardiography and as such details the electrophysiology of the heart, normal and abnormal. Part two deals with clinical electrocardiography. Part three deals with arrhythmias and the effects of digitalis and quinidine. The author makes a brief presentation of vector cardiography but emphasizes those aspects of electrocardiography in which spatial orientation of the cardiac vector is important. The text is well written and the material easily understood. The illustrations are quite good. There is no bibliography. The book is recommended as a textbook for medical students and general practitioners.

ASCLEPIADES. His Life and Writings. A Translation of Cocchi's Life of Asclepiades and Gumpert's Fragments of Asclepiades. By *Robert Montraville Green, M.D.* Cloth. Price, \$6.00. Pp. 167. Elizabeth Licht, Publisher, 360 Fountain St., New Haven, Conn., 1955.

This book contains substantially all that remains of the life and opinions of Asclepiades of Bythinia, who practiced in Rome during the first century A.D. Previously, Rome managed for 600 years without physicians, relying on folk-medicine, magic and intuitive hygiene. Both Pliny the Elder and Cato deplored the immigrant stream of Greek physician-philosophers which began in their time and reached its culmination in Galen.

Others, such as Cicero—who seems to have known Asclepiades—honored them, and Caesar in 46 A.D. granted them the privileges of Roman citizenship. No doubt some were both rapacious and ignorant and easy victims of the satirists.

Asclepiades was none of these. Trained in the Greek schools, he rejected many aspects of Hippocratic theory and built his system upon the philosophic concepts of Epicurus and Lucretius. His theories and those he disputed have long since lost their meaning. But, like so many ancients and some moderns, his practice was better than his precept. He pioneered in the humane treatment of the mentally ill. He directed specific attention to chronic disease and to the problems of the aged, recommending pleasant surroundings and appropriate musical and occupational therapy. He used vapor and cold baths, exercises in sand for the paralyzed and other technics which make him the first exponent of rational physical medicine.

Hence this book is dedicated to the memory of a former president of the American Congress of Physical Medicine and Rehabilitation, Dr. Walter M. Solomon, like Asclepiades a man of widely ranging talent. It stands also as a memorial to the translator, a late Emeritus Professor of Anatomy at Harvard. It is recommended to those in physical medicine who wish to learn more about the cultural background of their profession.

ELECTRODIAGNOSIS AND ELECTROMYOGRAPHY. Edited by *Sidney Licht, M.D.* Cloth. Price, \$10.00. Pp. 272, with 90 illustrations. Elizabeth Licht, Publisher, 360 Fountain St., New Haven, Conn., 1956.

Twelve of the world's outstanding authorities on electrodiagnosis and electromyography have contributed to this compilation of information. As in all cases of individual writers there is bound to be some over-lapping of information. This is not necessarily a fault, for when using the book as a reference there are many times when only one chapter or a part of a chapter will be read. The editor has done a fine piece of work in keeping a uniform style of semantics, grammar and English, even though chapters were written by foreign authorities.

The material presented has been compressed into relatively short chapters but the bibliography is elaborate enough for any interested reader who seeks additional information about a single subject. There is sufficient available material on each subject for a clinical understanding of the principles of technic, interpretation and the limitations of a given method. If a physician has a command of this information he will use the diagnostic services available in his hospital to great advantage to the patient and himself.

The use of footnotes in small type makes for difficult reading and a loss of continuity of thought. This is confusing to the reader and

distracts from the value of the material being read. It is hoped that in the future volumes this can be remedied.

It should be understood that this is a book of general, useful clinical information and not a "cook book" of technical procedures.

PATHOLOGIC PHYSIOLOGY. Mechanisms of Disease. Second edition. Edited by William A. Sodeman, M.D. Cloth. Price, \$13.00. Pp. 963, with 173 illustrations. W. B. Saunders Company, W. Washington Sq., Philadelphia 5, 1956.

This excellent book by twenty-nine specialists attempts to explain disease processes by answering the question of how exciting agents produce the various disease manifestations rather than discussing the agents as such. The book is divided into twelve parts and thirty-one chapters.

Each subject is discussed in considerable detail and with great clarity. Numerous graphs, photographs, and tables help for a better understanding of the text. This book is recommended to all physicians and students of medicine and physical medicine.

BIBLIOGRAPHIE DER SPORTMEDIZIN UND IHRER GRENZGEBIETE 1955. (Deutschsprachig) By E. J. Klaus, Dr. Med. Paper. Price, \$0.85. Pp. 96. Georg Thieme Verlag, Stuttgart, Germany and Intercontinental Medical Book Corporation, New York 16, 1956.

A previous volume contained the bibliography of German publications on the medical aspects of athletics for the years 1953 and 1954. The present volume, representing

mainly the year 1955 but including items omitted in its predecessor, contains about 1400 references. These are arranged alphabetically by authors. Then follows an excellent subject-index whereby all the references on any given topic can be located with ease. A curious observation is the extent to which English words like boxsport, stress, training, and doping have been assimilated into the German vocabulary; this phenomenon testifies to the international importance of the material. This book will be invaluable to many people concerned with athletic injuries and hygiene.

ANNUAL REVIEW OF MEDICINE. Vol. 7. Edited by David A. Ryland, M.D., and William Creger, M.D. Cloth. Price, \$7.00. Pp. 611. Annual Reviews, Inc., Stanford, Calif., 1956.

This year's review covers twenty-five subjects and has a final chapter with an annotated list of reviews in medicine. It contains reports of great importance on nutrition, endocrinology, psychiatry, pediatrics, diseases of the cardiovascular system, the kidney and the gastro-intestinal system, and cancer. Other fields are treated with more limitation in scope than desirable, such as diseases of bones and joints, of the nervous system, and laboratory aids. A review of pulmonary emphysema is especially informative. There are also chapters of great interest on sympathetic blocking agents and on immunity. The choice of subjects for this volume is most helpful for those who want to be informed about progress in clinical medicine and related fields and is directed to well-selected reading of original publications.

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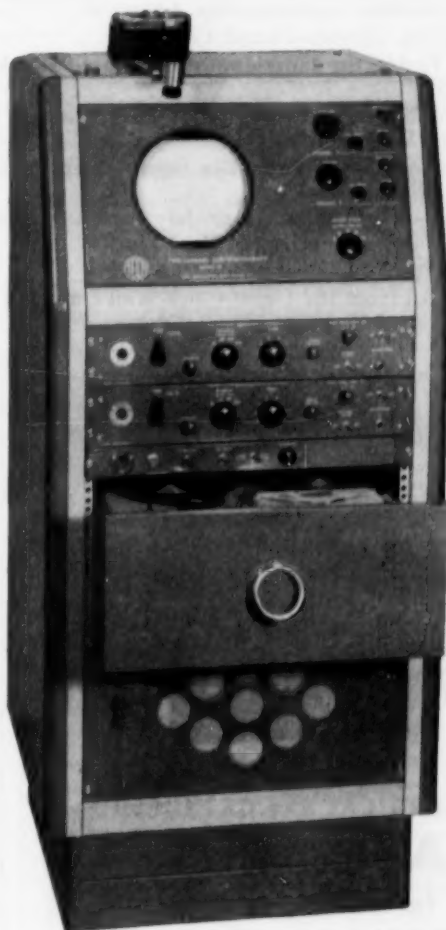
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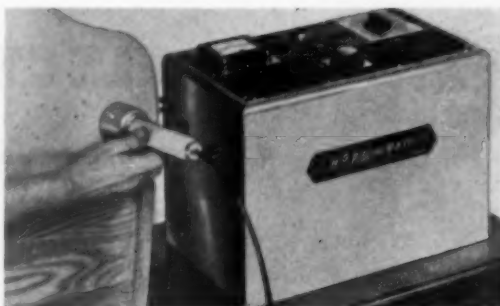


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WANTED

Registered Physical Therapists for immediate placement in established Crippled Children's Hospital and rapidly growing comprehensive Rehabilitation Center treating wide variety of patients. Well-equipped therapy department with pools and adequate space. Employee benefits. Maintenance if desired. Write: Jack E. Pearson, Morris Memorial Hospital and Rehabilitation Center, Milton, West Virginia.

WANTED: PHYSICAL THERAPIST, 1 year or more experience for STAFF POSITION. To work with children up to 21 years of age. Graduate of accredited school; good starting salary with regular increases; forty hour week, paid vacation, sick leave. 100 bed orthopedic hospital, new modern equipment. Write to Miss Anna B. Quinn, R.N., Administrator, Kosair Crippled Children Hospital, 982 Eastern Parkway, Louisville 17, Kentucky.

WANTED: Registered Physical Therapist (male preferred) to act as supervisor in Rehabilitation Department of Douglas County Hospital, Omaha, Nebraska. Staff of six includes RPT's and trained aids. Beginning salary \$4,800 plus liberal vacation and sick leave policies. For additional information, contact Mrs. Helen Feiler, Supervisor of Personnel Services, Douglas County Hospital.

PHYSIATRIST

WANTED for position of Medical Director of large well-equipped Rehabilitation Center in Hospital serving wide geographical area. Salary open. Apply: J. E. Pearson, Morris Memorial Hospital and Rehabilitation Center, Milton, W. Va.

OPPORTUNITIES AVAILABLE

WANTED: (a) Medical director; physiatrist; important foundation; medical school city, Midwest; \$15,000-\$18,000. (b) Physiatrist trained in cerebral palsy; Florida. For further information, please write Burnice Larson, Director, Medical Bureau, 900 N. Michigan Avenue, Chicago.
WANTED: OCCUPATIONAL THERAPISTS: (a) Two; state health agency; \$4,000. (b) Occupational and physical therapists; hospital for crippled children; resort town, South. **SPEECH THERAPIST:** (c) cerebral palsy center; medical director in charge of children's hospital; university town, Midwest; \$400-\$450. **PHYSICAL THERAPISTS:** (d) Chief; new voluntary general hospital; 300 beds completely air-conditioned; resort town, Southeast. (e) Two; 28-man group; university city, Southwest. (f) Chief and staff; minimum three years experience for chief; for staff, will accept recent graduate; 375 bed general hospital; college town, New Jersey short distance from New York City. (g) 300-bed general hospital; university affiliation; two American Board orthopedists on hospital staff; well-equipped air-conditioned department; university city, South. For further information regarding these opportunities, please write Burnice Larson, Medical Bureau, 900 N. Michigan Avenue, Chicago.

SELECTED OPPORTUNITIES

WANTED—PHYSICAL THERAPISTS: (a) Chief; outstanding opportunity to have full charge, est & build all new dept; close coop w/admin, other exec personnel; 130-bd gen hosp to be compl late '57; summer, winter resort, lovely coll city 50,000; MW. (b) Staff; fully appr'd vol gen hosp 250 bds; Impor univ city 100,000; SC. (c) Head dept, very lge psy hosp; symptomatic, rehab ther; to \$4800; E. (d) By 7-man clin grp, all major med spec; about \$4200; lovely twin 25,000; MW. (e) Staff; gen hosp 200 bds; to \$4800; well known resort city; W. (f) Staff; vol gen hosp 100 bds; appr'd JCAH; coll city 35,000; NW. (g) Staff; fully appr'd 300 bd gen hosp; to \$4800; city 50,000 nr impor univ med ctr; MidE. (h) Chief; 2 in dept, 200-bd hsp for chronically ill; \$4000, full mtc; univ city, E.

For further information, please write Woodward Medical Personnel Bureau, 185 North Wabash, Chicago.

AN EXPERIMENT IN MEDICAL NOMENCLATURE INTRODUCING THE TERM:

*"cell examination
for uterine cancer"*



The exfoliative cytological examination is called by some doctors the *cytologic cervical test*—by others the "*Pap*" smear test. In urging all women to have this test annually, we are calling it the *cell examination for uterine cancer*.

Here are our reasons:

Cytologic cervical test is a term which seems complicated to many women.

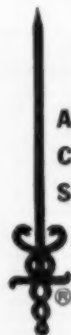
"*Pap*" smear test is simple, but women we have talked to find the word "smear" unpleasant and disturbing, and it may add to their anxieties about pelvic examinations.

Public relations advisors say that broadcasters and editors will dislike "smear"—and TV, radio and the press will be essential to the success of this educational project.

We have considered other terms but have at last agreed on *cell examination for uterine cancer* as the term which simply and accurately describes the keystone of this vitally important program.

This test can help save thousands of women each year. In many parts of the country it is becoming widely accepted as a part of a routine checkup. As fast as county medical societies approve, our local Units will urge women to go to their physicians annually for a *cell examination for uterine cancer*.

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SOCIETY



Announcing . . .

The Annual Prize Lecture

sponsored by the



**AMERICAN CONGRESS OF PHYSICAL
MEDICINE AND REHABILITATION**

To stimulate interest in the field of physical medicine and rehabilitation, the American Congress of Physical Medicine and Rehabilitation will award annually, a prize for an essay on any subject relating to physical medicine and rehabilitation. The contest, while open to anyone, is primarily directed to medical students, interns, residents, graduate students in the pre-clinical sciences and graduate students in physical medicine and rehabilitation. The Prize Lecture Committee suggests that members of the American Congress and American Academy of Physical Medicine and Rehabilitation bring this announcement to the attention of interested persons. The following rules and regulations apply to the contest:

1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.
2. Manuscripts **must be** in the office of the American Congress of Physical Medicine and Rehabilitation, 30 N. Michigan Ave., Chicago 2, not later than June 1, 1957.
3. Contributions will be accepted from medical students, interns, residents, graduate students in the pre-clinical sciences, and graduate students in physical medicine and rehabilitation.
4. The essay must not have been published previously.
5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the **ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION**.
6. Manuscripts must not exceed 3000 words (exclusive of headings, references, legends for cuts, tables, etc.), and the number of words should be stated on the title page. An original and one carbon copy of the manuscript must be submitted.
7. The winner shall receive a cash award of \$200, a gold medal properly engraved, a certificate of award and an invitation to present the contribution at the 35th Annual Session of the American Congress of Physical Medicine and Rehabilitation at Hotel Statler, Los Angeles, September 8-13, 1957.
8. The winners shall be determined by the Prize Lecture Committee composed of four members of the American Congress of Physical Medicine and Rehabilitation.
9. All manuscripts will be returned as soon as possible after the name of the winner is announced.
10. The American Congress of Physical Medicine and Rehabilitation reserves the right to make no award if, in the judgment of the Prize Lecture Committee, no contribution is acceptable. The Congress may also award certificates of merit to contributors whose essays may be considered second and third best submitted. Announcement of the winner will be made at the annual meeting.



TO HEAT OR NOT TO HEAT

IT HAS been shown that a very small increase of temperature within living animal tissue will increase the rate of the flow of blood through capillaries, veins and arteries many fold. (See report of studies of E. M. Landis & J. H. Gibbons, Jr., T. Lewis, Hildebrandt, A. W. Hewlett, R. Kovacs, Van't Hoff, G. Jorn, Cholnoky.) What point, therefore, in increasing temperatures to 104° F. or more as commonly achieved with SW diathermy. Perhaps excessive temperature increase accounts for some of the failures in achieving proper clinical results with diathermy or other heat mediums. We commercial chaps have to make excessively powerful equipment in order to sell it at all.

Isn't the heat developed in tissue from the passage of electrical energy simply the manifestation of the dissipation of the surplus electrical energy not otherwise used? Put 200 watts, say, in a good oscillator tube and under an engineer's control under ideal laboratory conditions; only about 140 watts of electrical energy is recovered, the rest dissipated in the form of radiated heat.

A couple of years ago I ran a series of tests on the human thigh of six students. This was accomplished in concert with two others; an eminent physiatrist and a physicist. Employing a SW diathermy of my own manufacture for a twenty-minute treating period, operating strictly at the subjects' comfortable tolerance, there were produced (as measured by an accurately calibrated thermocouple inserted $2\frac{1}{2}$ " below the surface of the skin) average temperatures in excess of 106° F. with only temperatures of 101° F. subcutaneously. The point, however, is this — this was accomplished with equipment not yet commercially available, but through the use of which *only actual watts absorbed* by the tissue were accurately measured. In this series only 75 watts or less were actually administered to the subjects. I suspect a good clinical dose of SW diathermy may be achieved with a mere 20 watts. Do you recall the early reports of Weissenberg while he was still in Vienna during the 30's indicating favorable clinical results while simply exposing a patient to a minimal HF field, inadequate to make a temperature rise apparent. This idea died aborning simply because someone mislabeled it "Athermic Diathermy," which means about as much as "Dry Water." Too, J. Samuels of Amsterdam has published many articles and his massive book has gone into several editions (two in English) continuing for twenty years to claim much for clinical use of HF electrical energy in tiny amounts in spite of the damning criticisms of his European medical colleagues. I understand Dr. Samuels has recently received formal recognition, however, in quite high and erudite scientific circles. Similar observations have been reported by Ginsberg in New York, and Adler and Magora of Jerusalem, Israel.

Few in America have studied and investigated works of Weissenberg and Samuels, and fewer have made

unbiased clinical investigations. Some, after a few hundred cases, have whispered to close colleagues rather amazed substantiations of such work but dared not risk publication.

We now have Ultrasonic energy. A few early investigators correctly reported that with high levels of this mechanical energy (30-50-60 acoustical watts) applied continuously to a given spot, great heat was quickly generated sufficient to destroy tissue. Someone then thoughtlessly mislabeled the therapy "Ultrasonic Diathermy" — simply because he himself up to this time could not account for what Ultrasonic energy did in live animal tissue other than create heat.

We now have a few good medical men talking about Ultrasonic heat, while 20,000 others continue daily to administer treatment with tiny amounts of energy (3 to 5 total watts with a continuously moving transducer) producing no measurable heat that can't be accounted for by friction alone, yet these 20,000 are proclaiming the achievement of most successful, sometimes amazing clinical results while paying little attention to why or how it works, in spite of the reports of other competent investigators of chemical and physical effects other than heat.

So — here we have a nice kettle of fish. On the one hand the majority of doctors, advocates of the rotiisserie school, employ vast quantities of SW diathermy — not hearing the faint chorus of the few who want the energy but not heat. On the other hand, in Ultrasonics we have the faint few who want to "cook 'em" with Ultrasonic energy as contrasted with the great majority who want no heat but to gently massage individual cells and tickle root nerves. All of this conditions we manufacturing fellows for a screaming visit to our respective psychiatrists. All of this makes for splendid controversial issues. Physical Medicine is so complex a mixture of physics and physiology, pathology and psychiatry, chemistry and manipulations, all flavored and spiced heavily with a great deal of hard work, that it lends itself to controversial viewpoints much more readily than any other medical specialty. It is a great credit to the grand medical men and women in Physical Medicine that such complexities can be partially solved — that such opposing positions may be taken with skulls fractured and toes stepped upon yet still with an ever-unified and stronger-growing specialty.

For me, as a purveyor of the tools of Physical Medicine, it has been a very gratifying experience for 31 years to be an observer in the growth of Physical Medicine and its adherents, and to be friends with some of its most delightful and rabid progenitors and protagonists.

Cordially yours,
C. J. BIRTCHER, President
The Birtcher Corporation

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